The Welding Engineer

Reg. U. S. Pat. Office

Founded by L. B. Mackenzie, 1916

JUNE, 1928 VOL. 13, NO. 6

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WILSON offers you the Correct Grade (analysis) of wire *for every welding job*

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Furnished Bare (uncoated) only. For flat, vertical and overhead welding. For general welding in steel in which medium ductility and tensile strength of about 50,000 lbs. to the sq. in. are sufficient; also, for cast iron where studs are used. Especially recommended for Fire-box Seams, Locomotive Frames, Boiler Flues (use ¼" dia.) and for filling and building up on Steel and Grey Iron Castings. Welds in steel are easily machineable. Diameters: ¼", 5/32", 3/16", 1/8", 5/32".

Grade No. 4

Pat. U. S. A., June 13, 1916

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Grade No. 6

Pat. U. S. A., June 13, 1916 (two patents) and March 9, 1920; Canada, March 19, 1918

Color-tipt "White." For flat, vertical and overhead welding on steel and cast iron. Has a copper content, and is especially suitable for weldirg the new steels having a copper content. Excellent for general work in repair shops, for structural steel frames, for building up worn places not subject to excessive wear, etc. Tensile strength: 50,000 to 55,000 lbs. in steel. Medium ductility. Readily machineable on steel. Supplied pot annealed in Grade No. 31. Diameters: 3/16", 5/32", 1/8".

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Pat. U. S. A., June 13, 1916; March 9, 1920

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Grade No. 12

Pat. U. S. A., April 6, 1920; August 30, 1921

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Grade No. 17

Pat. U. S. A., June 13, 1916; March 9, 1920

Color-tipt "Red." For flat, vertical and overhead welding. Especially adapted to general welding in steel where a minimum ductility and tensile strength of from 50,000 to 55,000 pounds per sq. in. are sufficient. Will also produce a sound weld in cast iron where steel studs are used. Welds on steel are easily machineable. Especially recommended for Fire-box Seams, Locomotive Frames, Boiler Flues (use 3/16" dia.) and for filling and building up on steel and grey iron castings. Supplied pot annealed in Grade No. 30. Diameters: ¼", 3/16", 5/32", 1/8", 5/32".

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Published monthly by the Welding Engineer Publishing Co. Entered as second class matter Jan. 20, 1916, at the Post Office at Chicago, Ill., under the Act of March 3, 1879.

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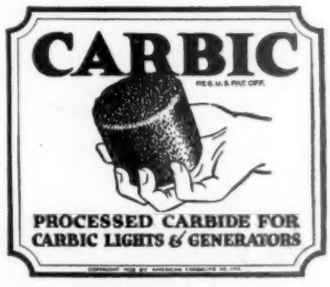

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The Welding Engineer

Founded by L. B. Mackenzie, 1916

Volume 13 | June 1928 | Number 6

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It Pays to Investigate Thoroughly

TWO research engineers got together one day to determine whether or not a new alloy could be used in a large manufacturing plant. After two hours of hard work no advantageous use for it could be found, but there were several hundred operations in the plant, so the study was continued until all possibilities had been exhausted. At the end of the day over two score places had been discovered where plant executives were delighted with the advantages promised by the new metal. These advantages would have been lost if the material had been judged by a casual survey. It is this thoroughness in getting acquainted with modern materials and modern processes which distinguishes a progressive business man from the laggard in the same line. The above experience is not a bit unusual in American manufacturing plants. It is, in fact, typical of those institutions which set the pace for industry. The "new-fangled" process always appears as a possible step forward to a live executive, who has learned by experience that improvements have a healthy effect upon dividends.

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The Welding Engineer does not publish in its news or advertising columns any matter that deals with or refers to either personal or legal controversies.

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Buyers' Index

Readers of The Welding Engineer will find this index to contain the most accurate information obtainable relating to welding apparatus and supplies. The advertising section includes the principal manufacturers of the United States.

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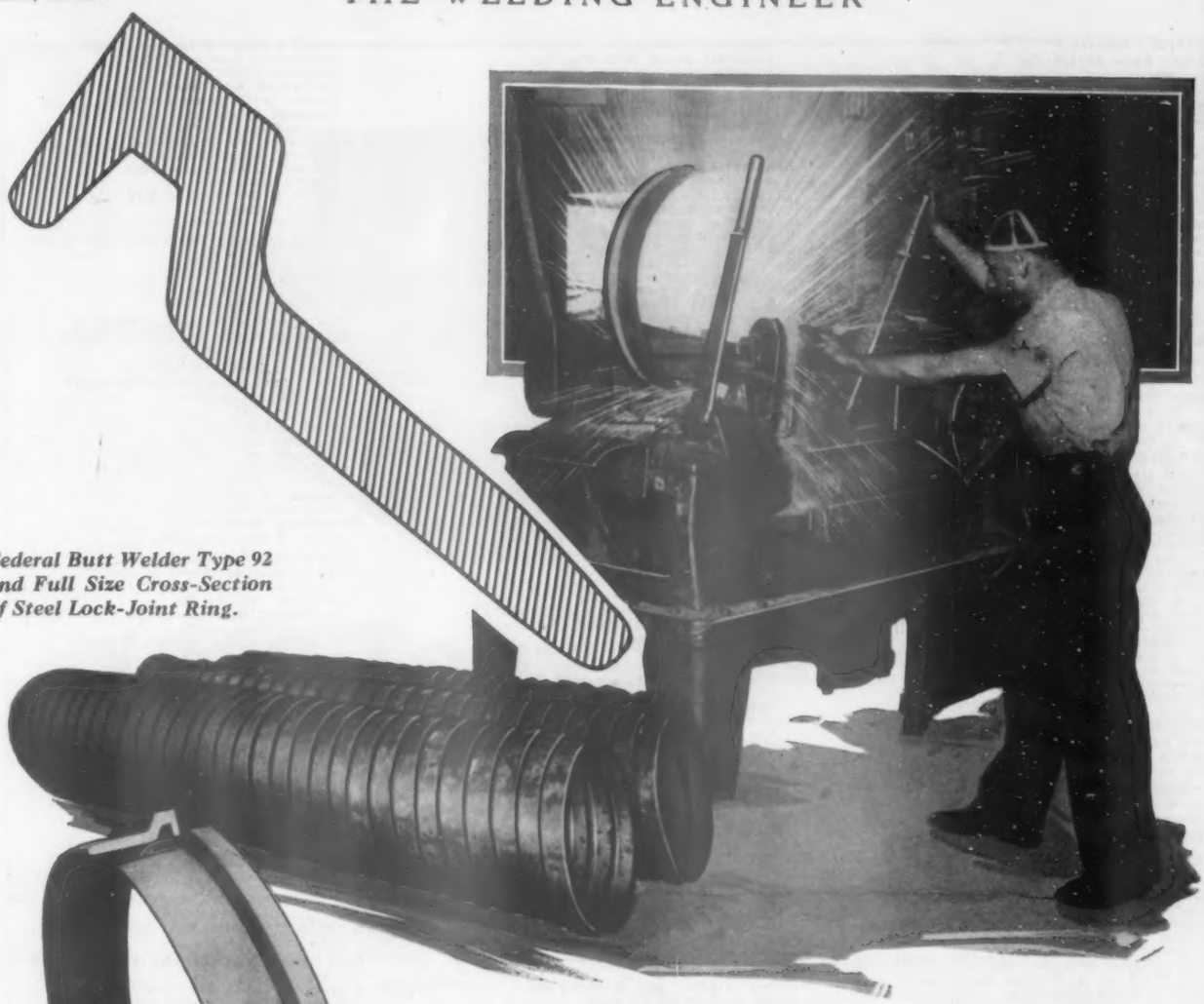

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1000 Tons of the Best

THREE large warehouses are kept generously stocked with the famous Swedox brands of welding rods, wires and electrodes. These are selected materials, chosen for their tested ability to make strong, sound welds. This preparedness to meet every welding need is responsible for the enviable reputation of Swedox service to the welding industry. For as long as the most experienced welder can remember Swedox wire has been instantly available and unfailingly dependable.

Such extensive stock carrying would be unnecessary if we believed that one analysis and one process could serve every welding purpose. But we have always believed that every welding job should be studied and a rod developed which would do it perfectly. Therefore, when you order from Swedox stocks you get wire which is suited to every requirement of your work.

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Extended
East 150

DETROIT, MICH.
5001 Bellevue Ave.
Whittier 6780

ACCESSORIES FOR WELDERS

A complete stock of all welding accessories, including goggles, helmets, shields, gloves, electrode holders, lenses, etc., is carried in each of our three warehouses. Include whatever accessories you need in your next order.

SWEDOX

WELDING RODS, WIRES and ELECTRODES

The Fallacy of Over-Emphasizing Electrode Price in Cost Distribution

MANY manufacturers have found that there is more to be considered than the actual *purchase* price of electrodes in applying the factor of welding material in production cost estimation.

The electrode which substantially reduces labor—both in actual welding and finishing—and current consumption, while producing a weld of the highest quality, is, in the final analysis, the most economical and efficient. QUASI-ARC Electrodes are scientifically designed on this principle, and our sixteen years of worldwide experience has proven it to be sound and practical.

Our experienced Engineers are prepared to prove the advantages of QUASI-ARC Electrodes by a practical demonstration in your own shop, at no obligation to you.

Quasi-Arc

Railway Crossings Still in Service Four Years After Being Reinforced With QUASI-ARC Electrodes. The average Life of a NEW Crossing on this Section is Four Years.

Crane Jib, Welded with Quasi-Arc Electrodes, which stood up satisfactorily under severe treatment in excavating heavy slag.

QUASI-ARC INCORPORATED

Sole Manufacturers of Quasi-Arc Electrodes and Welding Equipments and Consultants in Reference to their Application

11 WEST 42nd STREET, NEW YORK, N. Y.

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MONOLITHIC
ACETYLENE CYLINDERS

OXECO Monolithic Acetylene Cylinders have successfully undergone practically every conceivable kind of a test in actual service.

The result has always been the same, namely, 100% safety.

A LARGE majority of the acetylene producers of the United States have manufactured or purchased monolithic filled cylinders *at a premium*. Such producers are furnishing acetylene to their customers in the best and safest type of cylinders that the acetylene industry has developed.

Large consumers of acetylene who have investigated cylinder construction now specify *"monolithic filled cylinders"* in their acetylene contracts.

We do not sell acetylene gas. We are, however, one of the manufacturers of acetylene cylinders and have consistently advocated the use of monolithic filler.

We know that this type filler cannot deteriorate or sag and that it will perform its safety function throughout the life of the steel shell of the cylinder itself.

A booklet containing facts about acetylene cylinder construction will be mailed gladly to any acetylene user.

KEITH DUNHAM COMPANY

110 South Dearborn Street Chicago, Illinois

A plain statement of facts

MORE than twenty years ago the first commercial oxygen for welding and cutting was produced—Linde Oxygen.

From that day on, Linde has been the standard with which all others are compared.

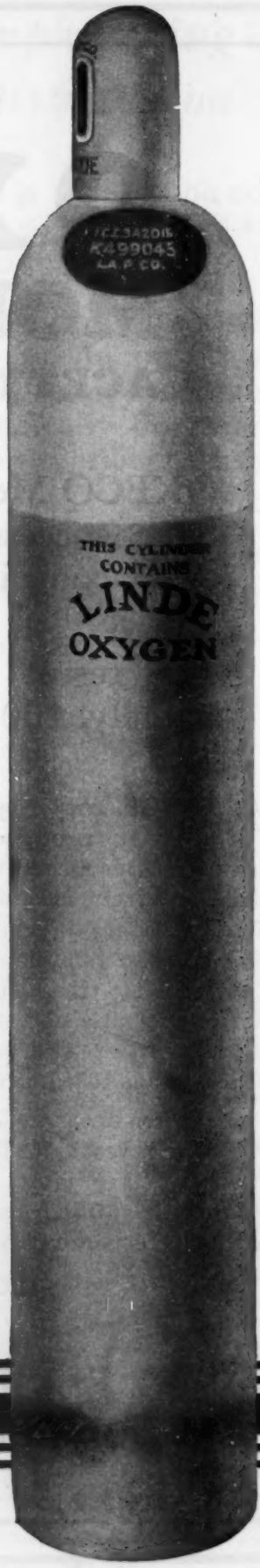
It has always had by far the largest sale of any oxygen.

There are three reasons for this:

—uniform high quality

—immediate delivery

—Linde Process Service—that insures the most economical results for Linde customers.



THE LINDE AIR PRODUCTS CO.
Unit of Union Carbide and Carbon Corporation
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General Offices: Carbide and Carbon Building
30 East 42d Street, New York

LINDE OXYGEN

There is no mystery in the success of

Prest-O-Lite
DISSOLVED ACETYLENE

A record of 23 years of uniform high quality, and delivery service from 37 plants and 102 warehouses, has established a national preference for Prest-O-Lite.

Tens of thousands of acetylene users rely on Prest-O-Lite for all their oxy-acetylene welding and cutting work.

Such confidence must be deserved.

THE PREST-O-LITE COMPANY, INC.
Unit of Union Carbide and Carbon Corporation

UCC

General Offices: Carbide and Carbon Building
30 East 42d St., New York
31 Plants—102 Warehouses

No. 1 High Test Welding Rod

Oxweld's answer to the demand for stronger welds

HIGHER pressures and greater stresses require steel welds of greater strength. To answer this new demand, Oxweld made the No. 1 High Test Welding Rod.

Any operator can produce welds with greater tensile strength by using No. 1 H. T. Rod. This has been proved time and again in all kinds of industrial work. A recent test in the welding shop of an oil refinery showed an increase of 9,000 pounds in the tensile strength of test welds on the first trial.

Moreover, welders can work faster with Oxweld H. T. Rod. This reduces welding costs.

Wherever the strength of welds is an important factor, it will pay you to use Oxweld High Test Welding Rod.

OXWELD ACETYLENE COMPANY
Unit of Union Carbide and Carbon Corporation

UCC

NEW YORK CITY, 30 E. 42d St. STOCKS IN 38 CITIES
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Oxweld

WELDING AND CUTTING APPARATUS

Welded "for Keeps"

Seams with the grip of a solid casting—that's what the welding superintendent requires. Such tough, lasting welds are being obtained with competent workmen, good welding equipment, and *G-E Welding Electrodes.*

G-E welding electrodes are easily manipulated. Stable, smooth arcs practically prevent sputtering and spattering. Welders can do more work and better work with less fatigue.

General Electric manufactures an electrode exactly suited to each kind of weld.

Type "F" is a bare wire treated by a special General Electric process to obtain a stable, concentrated arc. It is used for general welding of steel.

Type "B" is best for automatic welding. The concentrated arc confined by encasing the flux around the core in the sheath gives remarkable penetration for higher-speed welding.

Type "A" is recommended for cast iron.

In absolute reliability of operation and over-all efficiency, G-E Arc Welders are unequalled. They are available in all sizes, all types—for either hand or automatic operation — for one or more operators.

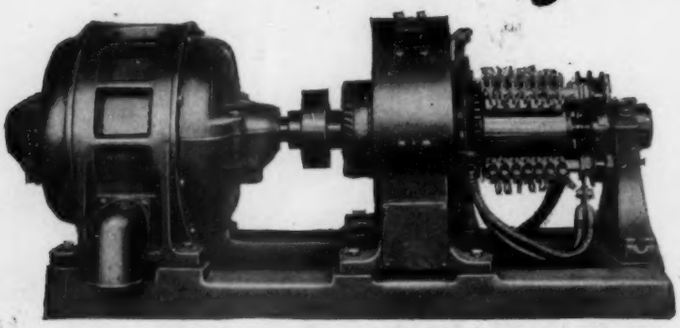
Special distributors for G-E welding electrodes are located throughout the country and are equipped to give you prompt service. Get in touch with the G-E Welding Electrode Distributor near you or write to the Merchandise Department, General Electric Company, Bridgeport, Connecticut.

550-202

GENERAL ELECTRIC

MERCHANDISE DEPARTMENT, BRIDGEPORT, CONNECTICUT

The more you arc weld



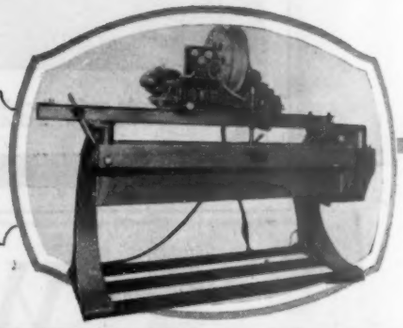
Multiple-operator sets—for simultaneous welding by a group of operators or for supplying power to automatic arc welders. Available in standard sizes from 400 to 1500 amperes

The more you arc weld, the more you save! The realization of this basic truth is rapidly and radically changing the nation's manufacturing methods.

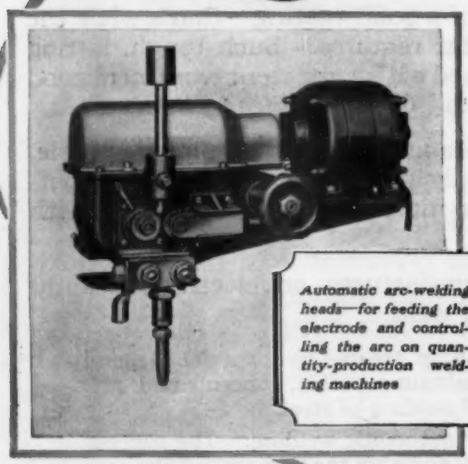
The "Arc Welding Age" has, to a large extent, come into existence as a result of developments by the G-E research laboratories and G-E welding engineers.

General Electric perfected the standard arc welding sets used to-day. It developed the automatic arc welder and made the first successful application of it.

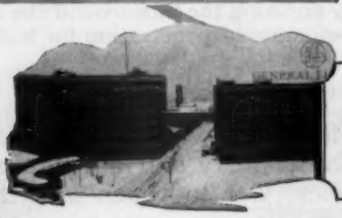
Automatic arc-welding machine—for quantity production of small tanks and pipes



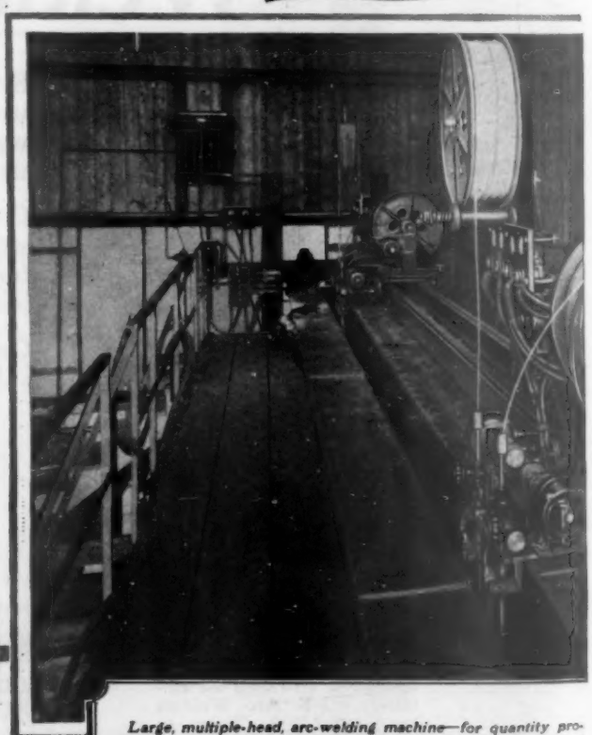
Electrodes—Type "F" for general welding of steel; Type "A" for welding cast iron; Type "B" for unequalled results in automatic welding



Automatic arc-welding heads—for feeding the electrode and controlling the arc on quantity-production welding machines



G-E Research Laboratories. Constantly at work in the interest of better arc welding



Large, multiple-head, arc-welding machine—for quantity production machine in use to-day. Equipped with four heads which

GENERAL

GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

the more you save

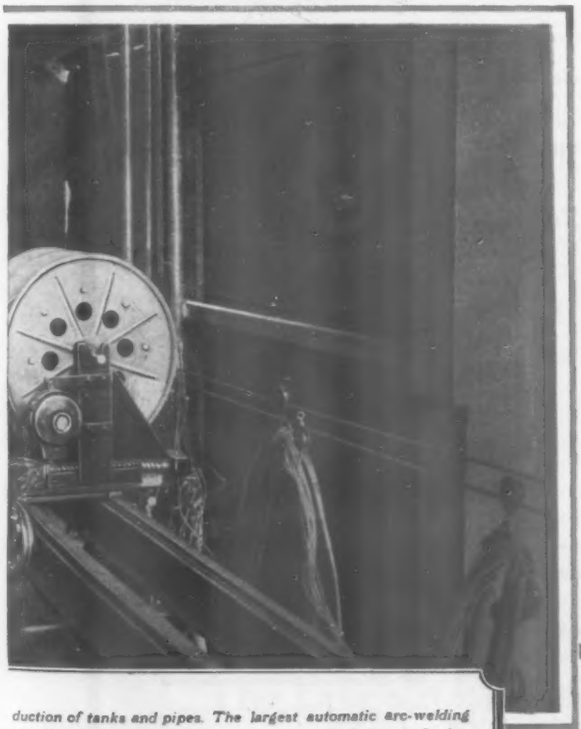
It originated the atomic-hydrogen arc welder. Its great research laboratories and its welding engineers are constantly working to develop new equipment and to discover new applications. Its arc welding school is making an invaluable contribution to better welding practice.

We present here a picture that indicates the completeness and the leadership of G-E arc-welding equipment and arc-welding service. Let the nearest G-E office be your headquarters for your every arc-welding requirement.

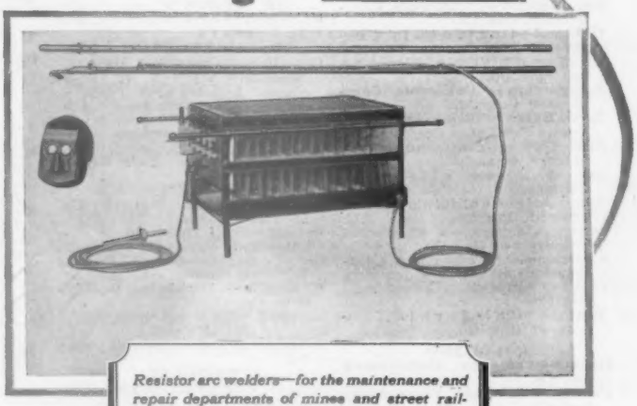
Single-operator sets—for all general welding work. Available in three sizes—200 amperes, 300 amperes, and 400 amperes

Atomic-hydrogen arc welder—for welding very thin metals or metals and alloys hitherto considered unweldable

Accessories for the welder: helmets, face-shields, electrode holders, welding cable, etc.



duction of tanks and pipes. The largest automatic arc-welding simultaneously weld longitudinal seams on large steel pipe



Resistor arc welders—for the maintenance and repair departments of mines and street railways. Operate directly from trolley circuits

G-E arc-welding school. Free instruction. Conducted in the interest of better welding

530-40

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Patronize Your Local Oxygen Plant

SPEND YOUR DOLLARS AT HOME
for
OXYGEN

ACETYLENE WELDING EQUIPMENT — CARBIDE — HYDROGEN CUTTING EQUIPMENT

Members of the Gas Products Association can give you prompt and efficient service from over 100 plants and warehouses located throughout the country.
These are your local industries from which you will always obtain courteous, personal service. From them you will secure the highest purity of oxygen, acetylene and hydrogen and technical service, if you require it, concerning your welding and cutting problems.
Have you received your copy of the "Gas Welding and Cutting Flame?" It will tell you many interesting things about welding and cutting.
Write or wire to the nearest plant asking for a salesman or a service engineer, as your requirements may demand.

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Green Bay—Universal Oxygen Co.
Janesville—Wisconsin Oxygen-Hydrogen Co.
Kenosha—Wisconsin Oxygen-Hydrogen Co.
Lake Geneva—Wisconsin Oxygen-Hydrogen Co.
Madison—Universal Oxygen Co.
Manitowoc—Universal Oxygen Co.
Milwaukee—Universal Oxygen Co.
Oshkosh — Wisconsin Oxygen-Hydrogen Co.
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HAWAII
Honolulu—Hawaiian Gas Products, Ltd.

BOLD FACE TYPE signifies Manufacturing Plants.
LIGHT FACE TYPE indicates warehouses.

Gas Products Association

333 N. Michigan Ave. Chicago, Ill.

First to Advocate High Purity Oxygen

Pop learns there is a difference in welding rods.

"Here, Lad .....

I got ahold of a sample of that 'Stable-Arc' welding rod that you tell me everyone has gone to. Frankly I don't see where it's any different from the regular rod we've been using."

Only "Stable-Arc" Welders have all these features

Variable Voltage.
Laminated Magnetic Circuit.
Separately-excited Generator Field.
Double Control of Welding Heat.
Steady Arc Throughout Entire Welding Range.
All Steel Construction.
Full Capacity for either Metallic or Carbon Arc Welding.

These features make welding easier. Results—better welds and greater output.

Ask any Operator!

"No, Pop .....

you're not supposed to **see** the difference but to HEAR it.

It's the operator who can SEE the difference in the free-flowing weld he makes.

He can FEEL the difference too because the Lincoln Stable-Arc BLUE rod is non-splashing.

But you should HEAR the difference from the operator—he needs the best rod there is to do the best job.

And you should HEAR the difference from our customers who would praise the work our operators turn out.

And that would mean more dollars for our shop.

And if you can't see the difference, you're color blind because the Stable-Arc rod is BLUE—but history fails to record a single case where a color-blind person has ever overlooked a greenback."

The Lincoln Electric Co., Dept. No. 27-6, Cleveland, Ohio

W-45

LINCOLN "Stable-Arc" WELDER

Photo by Courtesy of
AUSTIN WELDING WORKS, CHICAGO

Oil Tight Full Strength Seams— a job for

Mueller
WELDING
BRONZE ROD

THIS cylinder lining of brass sheet is one of many articles which can be successfully made only by bronze welding. High strength, absolute tightness, freedom from distortion and no injury to the parent metal are prominent advantages of bronze in thousands of such operations. Incidentally, bronze is widely used for strong, tight seams on tanks of all sizes.

Mueller Welding Bronze fuses quickly, melts at low temperature and flows evenly and freely. Absence of porosity eliminates sputtering and explosions. Make sure of the quality of your work— use Mueller Welding Bronze Rod. Let us send you your free sample. Write us today.

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Red Tip Brass Rod
Relleum Brass Forgings
Niag Nickel Silver Rod and Forgings
Tuf-Stuf Rod and Forgings
(*Corrosion Resisting Metal*)
Sandcraft Brass Castings
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Brass and Copper Seamless Tubing
Mueller Blue Tip Bronze Welding Rod

Mueller Brass Co.
PORT HURON MICHIGAN
DETROIT DISTRICT

Mueller Brass

THREE GENERATIONS OF BRASS MAKING

An entirely NEW welding principle is built into the OWEN INDUCTION ARC WELDER

Furnished with complete equipment as illustrated, ready to install and operate.

It was a practical study of the welder's needs that produced the OWEN

After fourteen years of research, experimentation, and constant use of working models put to every test, *in actual production and shop work,* the first Owen Induction A. C. Arc Welder was built. An additional four years were spent in observation of the work of numerous models, finally bringing this ingeniously simple machine to a high state of perfection.

The result is a welder that meets every welding requirement. Two of the distinguishing features of the Owen are the constant low voltage across the arc, and the magnetic pull through the arc, facilitating both ease and speed in welding.

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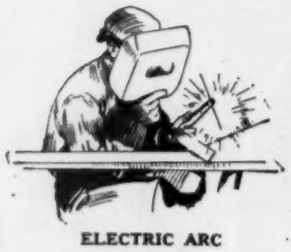

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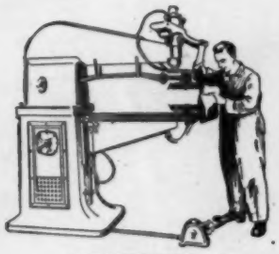

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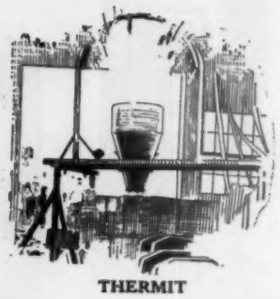

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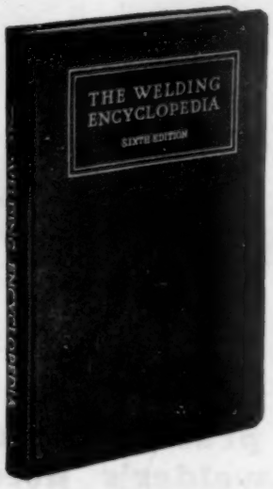

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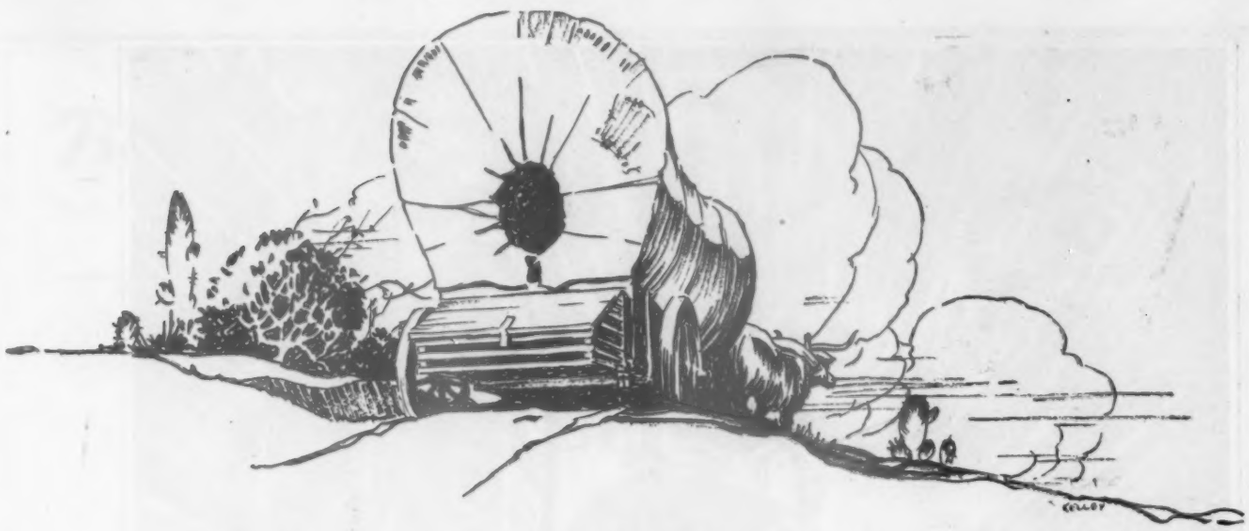

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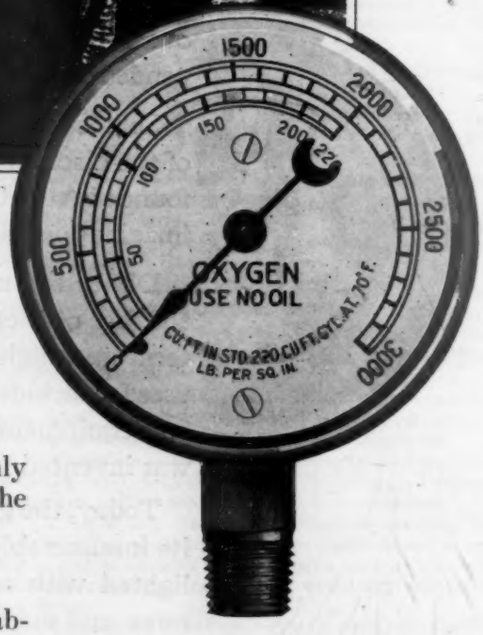

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EDITORIAL

Make the Exhibits Pay

THE use of exhibit space at industrial expositions for the purpose of selling equipment and supplies to selected groups of visitors at these expositions has grown to enormous proportions in this country, and executives of large companies who are attracted to a number of different types of expositions are obliged to give serious thought to the arrangement and the operation of their exhibits in order to keep down the high cost of presenting their products to the visiting public in this manner. The possibilities of making personal contacts with large groups of possible buyers is to the inexperienced exhibitor a temptation to overdo the matter of expense. It takes one or two experiences at least to teach the exhibitor how to side-step or reduce numerous overcharges and unnecessary expenses to which he may be put by holders of various kinds of concessions. The same is true of literature and souvenirs distributed from booths. Only experience will teach how to eliminate waste in this item. The volume of extra expense involved in a miscellaneous assortment of small items reaches a surprising total and may make the actual rental space of a booth look like a small item of the expense. In the case of large working exhibits time and labor become very serious factors. This part of the expense is accumulated before the exhibit and the period after the exhibit when material is being unpacked, set up, dismantled, and repacked for shipment. Experienced exhibitors often use very carefully made packing cases from which it is easy to remove the exhibit material, and paint special markings on them so that they are easily found in the storage room. One manufacturer has constructed packing cases in a very ingenious manner so that after they are unpacked they can be folded back, dusted off and used for booth furniture. The slight saving of rental on furniture is in itself not enough to justify such careful construction of the shipping containers. The big advantage of using them is the tremendous reduction in the cost of setting up and taking down the complete exhibit. There is at present no regular established means of exchanging ideas on practical methods of getting the most in the way of results out of industrial exhibits at the least possible expense. Many associations, however, are in the habit of operating large exhibitions in connection with an annual meeting. Some of these might well get together through committees and make a study of the subject in order to be able to recommend to their members and to prospective exhibitors at their shows ways and means to make an exhibit pay and keep the cost down. They would do well also to try to keep a check on those who try to exploit exhibitors. for the industrial exhibit is unquestionably a popular sales medium at the present time and can well expect to retain its popularity if means are adopted to keep it working at the highest possible efficiency.

Good Talent Needed

STANDARDS of procedure for various types of fusion welding operations are very much in demand today. Engineers who have suddenly thrust upon them the information that welding is too good to get along without have a tendency to side-step the job of becoming fully familiar with the process. They call loudly for standards and codes of all kinds, with the idea of getting information which they ought have in such shape that it can easily be passed on to somebody else who can be charged with the responsibility of getting the work done properly. The industry will have to wait for some time before it can come anywhere near filling the various kinds of demands of this sort. Too many of the possible operations are still in the development stage. However, a number of important corporations have solved the problem in a more practical and logical way. In some of the largest industrial plants in the country research engineers of the very highest type and best capability have been turned aside from other work and given instructions to make a thorough study of welding and develop standards of practice which their employers can use to advantage. Wherever this has been done it is noticeable that the welding operations of these organizations gain an enviable reputation. This is usually true not only from the standpoint of quality of workmanship but also from the standpoint of economy of operation. There is no doubt that the possibilities of welding are so great that the use of the best possible talent for its development is fully justified.

Real Competition

IT is hard to tell at present just what possibilities are in the future for the replacement of castings by welded rolled steel shapes. The idea has been developing for two or three years and its application has been seen in a range of products, from very small articles up to structures weighing many tons. Some claims which have been made for the welded article have been disputed on the basis that the cost of castings has been unduly exaggerated. It is interesting to note, therefore, that one welding engineer has the job of extending the use of welding in competition with castings in a plant where the cost of castings is figured at 4½c per pound. At last reports he was still making progress and anticipated future need for additional equipment. It will take some time to get a real good average comparison between a welded product and the corresponding castings. The casting has been on the job a long while and in a position to give the welder some real competition. It is important, therefore, that we do not overlook that advantages which are represented by the working qualities of the finished product.

When is a Welding Engineer?

THIS question was put to us the other day by a young man who is ambitious to advance in the welding industry, and who would like to qualify as a welding engineer. We are repeating here, in part, the answer we gave him because we feel that every man responsible for welding production should understand thoroughly all of the qualifications of a welding engineer. *First*—He should know the scientific fundamentals of all of the welding processes. *Second*—He should develop a reasonable degree of manual skill in performing welding operations. *Third*—He should acquire a sufficient knowledge of metallurgy and metallography to understand the structural changes in the metals resulting from the welding operations. *Fourth*—He should be capable of adjusting his ideas of design so as to be able to redesign a product to gain all of the advantages of strength, durability, weight, cost and appearance which welded construction offers. *Fifth*—He should be familiar with the advantages of each of the welding processes, so that he can specify for each job the process best adopted for that job. *Sixth*—He should know the various makes of welding apparatus and supplies. and should be able, for example, to choose the right filler metal to give the required properties to the weld. *Seventh*—He should be able to select and train dependable operators, and to organize an efficient force of welders for repair, construction or production work.

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Weldery on Production Basis

Pittsburgh Plant Improves Metal Products by Giving Customers Welded Steel to Replace Various Types of Castings

FOR several years the importance of welding as a production process has been the subject of constant study and discussion by prominent men in the industry. Great strides have been made in extending the use of welding in all kinds of metal working plants during that period, starting out first with the substitution of welding for riveting and other types of joints without making radical changes in the design, then improving welded products by changing the design so as to take advantage of every feature of the welded joint, and finally developing methods of entirely redesigning metal products both as to shape and as to material used so as to find still further uses of welding in production. Such redesign activities can only be accomplished by an organization which is thoroughly familiar with all phases of welding. For this reason many of the largest industrial plants in the country have established welding departments in charge of competent

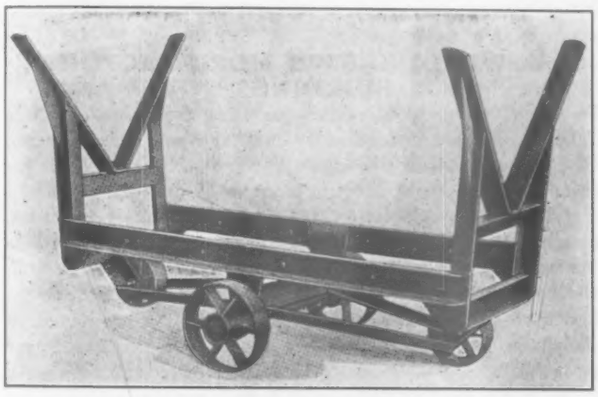

Fig. 1—"Weldsteel" Truck for Wire Mills

engineers so that all applications of welding will be made on a thoroughly scientific basis. There are some plants, however, which are not equipped to devote study to the subject but whose products or equipment might well be improved by taking advantage of welded construction. An article in the April, 1928, issue of *The Welding Engineer* pointed out that this condition opened up an opportunity for the operation of a plant which could be styled a "Steel Weldery" and whose work would correspond in a way to that of a steel foundry which produces castings for manufacturers whose requirements do not justify the installation of private foundries. There was quite a bit of discussion of the possibility of such an institution being successful and many interesting points of view were presented along with the article mentioned. People who have been following this discussion will probably be interested to learn of the activities of a plant whose operations correspond very closely to the idea presented by the author who advocated so strongly the establishment of steel welderies.

The organization referred to is that of the Pittsburgh Producers Supply Company, Pittsburgh, Pennsylvania. This is an organization of engineers and manufacturers specializing in welding and machine work. The main office and works is located at 1115 Metropolitan Street, Pittsburgh, and is under the management of Mr. R. H. Banks and Mr. W. L. James. Different members of this organization have been making a study of welded products for the past 14 years. A part of this time was spent with other concerns but for the past 6 years they have been operating under the name of the Pittsburgh Producers Supply Company. Probably the best way to judge the variety and importance of the work being done at this plant is to refer to some of the illustrations reproduced herewith showing a collection of typical jobs.

All of the items illustrated have been entirely reconstructed to be assembled by the welding process, and the trade name *"Weldsteel"* has been adopted to identify the products of this

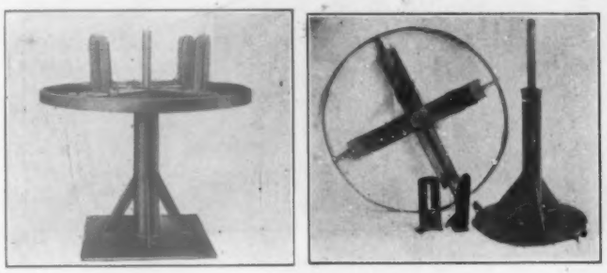

Fig. 2—Welded Steel Wire Reels

plant. Figure 1 shows an all steel welded truck such as used by the wire mill trade. These trucks are assembled from structural shapes, even to the wheels, entirely by the electric welding process and are put through the plant on production basis. Note that these trucks are so designed that it is entirely a matter of jig work. At the present time the company is making about two hundred of these trucks for one company.

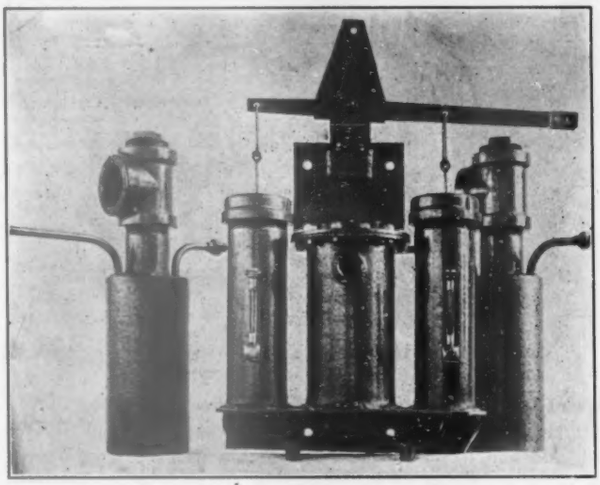

Fig. 3—All Welded Testing Apparatus

Figure 2 shows an all steel *"Weldsteel"* welded wire reel This article in former days was made of cast iron, and later of cast steel. This was used on account of the enormous breakage when cast iron reels were upset. The Pittsburgh firm have developed and are manufacturing these reels in various sizes, entirely from structural shapes welded, as evidenced by the photograph, and are receiving orders for lots of from twenty-five to one hundred.

Figure 3 shows a special set-up of cylinders arranged for testing purposes, and used in a chemical plant. It was originally designed to be made of cast iron, and re-designed by the engineers of the Pittsburgh Producers Supply Co. to be assembled by the welding process. The result was that many troublesome connections were eliminated, weight was cut down considerably, and the cost to the customer was less than half of the lowest quotation he received for casting it. The drain pipe at the base, under the old design, consisted of twelve pieces made up of nipples, ells, unions, and tees.

These are only a few of the commodities turned out on a production basis. The price at which these articles can be

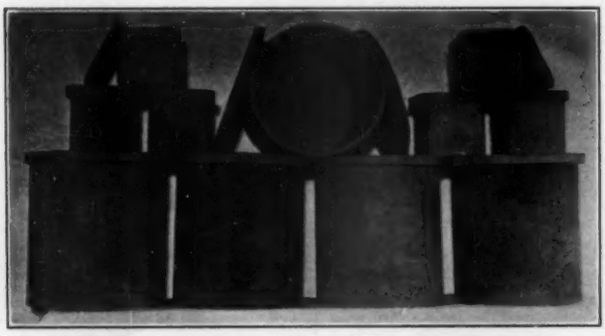

Fig. 4—Welded Carbonizing Boxes

sold to customers compares well with cast iron types, and is about equal to the cast steel price, with the advantages of the lightness and durability.

Some of the biggest items which have been developed and are selling to many large manufacturers throughout the eastern part of the country are Heat and Acid Resisting Carbonizing Boxes (Figure 4) used by the Automotive and Manufacturing trade, and Heat and Acid Resisting Pipes, Tubes, and Fit-

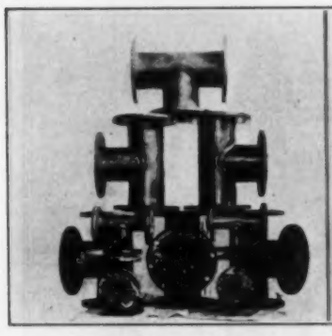

Fig. 5—Special Fittings

Fig. 6—Gas Cylinder Truck

tings (Figure 5), for use in mines and chemical plants. These items formerly were made of cast iron, cast steel, and pressed steel, and had to be replaced often. On items of this nature, due to the high cost of heat resisting metals, the original cost exceeds the cost of steel or cast iron, but the long life of articles welded from these alloy steels more than warrants the initial cost, as the life is many times that of cast steel or cast iron, and progressive engineers are quick to see this advantage.

Figure 4 illustrates beautifully the neatness of the work performed; these carbonizing boxes, formed from heat-resisting alloy steel sheets and welded are turned out on a production basis for manufacturing companies throughout the country.

Probably 75 per cent of this work is designed to suit the purchasers. Every problem they present is different, and must be worked out individually, to allow the welded sections to conform to the former cast iron or cast steel sections. This is often worked out to make a lighter weight commodity, due to the fact that they can insert gussets to strengthen sections where it would be impossible to put them on a casting, because of the under-cut, which would prevent pattern from putting out of the sand.

Many features and details in connection with the work were developed and designed by their own engineers, the basic principles, however, being designed by the purchaser. They pride themselves on working with engineers who are interested in welded steel commodities, and are always willing to help out to the best of their ability.

On the 15th of May the company moved into a new plant at 1115-1117 Metropolitan Street, N. S., Pittsburgh, Pa., which is considerably larger than their old plant and will permit them to handle a larger volume of production work. They have a large machine shop in connection with the welding plant so that all forming dies, jigs, tools and finishing can be under their own supervision.

Comparing the intricate job illustrated in Figure 3 with the simple all welded steel gas cylinder truck shown in Figure 6, and filling in with jobs of an intermediate nature which are also illustrated, the possibilities of production welding seem to be almost without limitations. The steel weldery is an institution which can serve many different kinds of industrial plants, particularly when manned by an organization of engineers who are able to mix welding with correct design principles.

G. E. WELDING TWO MORE FACTORY BUILDINGS

Two new factory buildings, all the structural work of which will be arc welded instead of riveted, are now being erected by the General Electric Company. One of these will be an addition to the General Electric plant in Bridgeport, Connecticut, and the other will be located at the company's Pittsfield, Massachusetts, plant. These mark a second step in the General Electric program, recently announced, of utilizing welding in the construction of its new buildings.

The first General Electric welded building was erected in Philadelphia, Pennsylvania, as an addition to the switchgear manufacturing plant there. This structure, approximately 140 feet wide, 600 feet long and 50 feet high, contains about 1,000 tons of welded structural work, and is chiefly notable because of the large number of welded trusses used in the roof structure, and the fact that it is the heaviest and largest steel structure thus far welded.

The new building at Bridgeport is to be a small, single-story structure, 64 feet wide and 42 feet long. It will connect two existing buildings in which wire and cable are manufactured, thus making them into one. It will require about 16 tons of steel. The Pittsfield building will be a two-story structure of beam and column construction, about 40 feet wide by 280 feet long, and containing about 250 tons of steel. The building will be of steel frame, brick pilasters, base and cornice, and steel sash. Floors and roof will be of concrete. It will be used in the manufacture of molded products.

The General Electric Company has found that less steel is required in the design of trusses for such buildings, resulting in appreciable savings in cost. Furthermore, the steel is fabricated without the noise of the riveting hammer, and simpler sections can be used.

The trusses in the Bridgeport building are of 64-foot span and are unique in design, utilizing upper and lower chord sections each consisting of half of a rolled I-beam. This beam is split in half by the use of a torch and, because of the large amount of webb left, the single-angle web members can be directly welded to the web of the chord members.

Fabrication of the trusses and other complete members will be done by the American Bridge Company in its Trenton, N. J., plant, where the trusses for the Philadelphia building were also constructed.

Construction of the two new buildings is under way. It is expected that both will be completed and ready for occupancy before fall.

Strength of Cast Iron Welds*

A Study of Some of the Effects of Thermal Treatment on Cast Iron Welded by the Oxy-Acetylene Process

By R. H. Hobrock† and J. P. Walsted†

THE welding of cast iron, very difficult until the invention of the torch, arc and thermit processes of welding, is now a common feature of maintenance in manufacturing plants. Cast iron parts are salvaged and returned to use when they become broken. In the foundries many castings are saved which would otherwise be classed as wasters and returned to the scrap heap. Yet with the rapid increase in application of welding to the industries, little research has been done on the effect of the welding process on the metal welded.

One frequently hears the claim made that a weld is stronger than the original metal, with the statement in proof that the casting will break alongside the weld rather than in the weld. This may be true and in the light of recent experience it seems to be true, yet if the casting breaks alongside the weld at a lower load than that required to break the original bar, then the welding has weakened the casting. It seems then that some information on the proper conditions for welding and on the thermal treatment of the welded piece after the welding has been completed, would be of value.

Such information concerning the treatment of the welded piece is of great importance to foundries and users of cast iron parts. The number of wasters salvaged in the foundries now amounts to vast sums. The salvaging of machine parts that become broken saves large amounts in money but even greater savings are made in time. A machine can often be repaired and put back into service in a fraction of the time necessary to procure and place a new part, thereby shortening the time the machine is kept out of production.

In welding by the Oxy-acetylene process the metal to be welded is first preheated. If the casting is large it is heated in a furnace, if small, it is heated by the welding torch playing on the metal near the place to be welded. When heated, the metal at the fracture is fused, at the same time metal from a rod, similar to the metal being welded, is deposited on the fused metal from the casting. The molten metal is then kept hot by the flame while it is being deposited over the entire area to be welded. In this way molten metal is allowed *to fill* the cavity to be welded and at the same time to unite with the metal of the casting.

The Physical Effects of Heating the Welded Sections.

In order to heat the metal sufficiently the flame must play directly on the parts to be welded. This is severe treatment for any metal and especially so for cast iron which is very sensitive to conditions of heating and cooling. It seems rather evident that the metal cannot be subjected to this treatment and come out the same as it was before the treatment. Moreover, an intense heat prevails at the zone of fusion while a very small fraction of an inch away the metal is solid. From the weld the temperature of the metal drops rapidly so that in a very short distance a range of several hundred degrees in temperature may exist. Such large temperature gradients will produce large internal strains in the parts welded and if the metal cools rapidly without provision being made for the removal of such strains the metal will be correspondingly weakened.

The Effects of Heating and Fusion on the Chemical Composition of the Welded Section and on the Welding Rod.

The welding flame will also affect the impurities in the metal. Some impurities are easily oxidized, others are not. Manganese, silicon and carbon belong to the former class, while phosphorus and sulphur belong to the latter. Such changes in the chemical composition of the iron will affect its physical properties very much. The changing of combined carbon to graphitic carbon is one that is easiliy brought about by heating and annealing processes and greatly decreases the strength of the specimen so treated[1].

Not only is the chemical composition of the specimen being welded, changed by this heating with the torch, but also the composition of the welding rod might be changed a great deal during the process of fusion and deposition. Then after the completion of the weld there might exist two materials of quite different chemical composition and different physical properties in very intimate contact with each other. If the coefficients of expansion of the two materials are not the same any change in the temperature of the composite piece will produce strains in the metal which will weaken the whole.

The Change in Chemical Composition of the Welding Rod Caused by Fusion.

In order to investigate the effect of melting the welding rod with the torch upon its chemical composition it was necessary to devise some method of obtaining this melted material without contamination from other surrounding metal. This was accomplished by filling a one and one-half inch pipe one and one-half inches long with the molten rod by the use of the torch. Care was taken to fill the pipe without fusing any of the material of the pipe. This specimen was then set up in a lathe and the outside pipe machined off. This left a cylinder of weld metal which was sampled for analysis. The result is given in Table No. 9.

Table No. 9

	Si.	Mn.	C.	P.	S.
Before Fusion	3.06	.550	3.32	.614	.103
After Fusion	2.76	.471	3.06	.622	.098
Change	— .30	—.079	— .26	+.008	—.005

The change in composition is similar to the change in composition when melting iron in cupola. The loss of silicon .30% or a loss of 10% of the silicon present is the standard for calculating the analysis of cupola metal at the spout. Some manganese is also lost as would be expected. Carbon being easily burned is also lost to a certain extent. The slight increase in phosphorus can be explained by the fact that the other elements decrease and some of the iron is also burned away. As no phosphorus is lost the same amount of phosphorus will be a larger percent of the resulting metal. However, the change is so small as to be almost negligible. The sulphur loss is so small that it falls within the limit of error of the determination.

The Preparation and Chemical Analysis of the Test Bars.

In order to make the welding of the test bars easy it was decided to use a specimen one inch square and fourteen inches long. To do this the bars were cast on their sides approxi-

This investigation is one of the projects of research regularly carried on by the Engineering Experiment Station in the Department of Practical Mechanics at Purdue University.

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(1) See "Improving the Strength of Cast Iron by Heat Treatment," by O. W. Potter, Foundry, June 1 and June 15, 1927.

mately one and one-quarter inches square and were machined to size.

Ten of these bars were selected from the different portions of the heat and analyzed, with the following average result.

Average of Ten Bars.

2.57% Silicon, .500% Manganese, 3.20% Carbon, .734% Phosphorus, .097% Sulfur.

The Method of Welding the Broken Bars.

After the machined bars had been broken and the breaking load and flexure recorded, the two halves were beveled from top to bottom so that when placed together the double V would be at the top and bottom as cast and as tested. They were then welded by the Oxy-acetylene flame using a good quality of cast iron welding rod. Some excess metal was built up around the weld in order to insure a full weld. In every case the specimens were either machined or ground to the one inch square section before being again tested.

The Method of Making the Tests.

All of the bars were tested transversely by applying a load at the center of a bar that was supported 12 inches apart. The breaking load and the amount of flexure just before rupture were recorded.

The Tests.

The first twenty-seven bars were broken and the strength recorded. They were then welded and allowed to air cool, machined to size and tested again. The results are given in Table No. 2, below.

Table No. 2

The Average of 27 bars tested.

Breaking load in pounds.		Deflection.	
Before welding	After welding	Before welding	After welding
2108 ± 74	1964 ± 128	.155 inches	.116 inches

The plus or minus values shown in the table are the "probable errors." The magnitude of the probable error in relation to the average (shown by the first figure) may serve to show the reliability of the average value. Thus the figure 2108 ± 74 means that the chances are equal that if similar test were made the value for that test would fall between 2034 and 2182 or outside of these values; that is, below 2034 or above 2181. In the above case the probable error of the breaking load after welding is much larger than before—this means that we must include a much wider variation in order to make the chances equal that the breaking load will fall inside of or outside of these limits. The probable error has been calculated in various places in this paper in order to indicate in some fashion the reliability of the average value. The probable error has been used rather than the index of precision because of the ease with which it may be comprehended by the casual reader.

From the result of these tests we may conclude that, under the conditions of these tests, (1) the strength of the cast iron is decreased by welding, (2) the reliability (our feeling of assurance that the bar will bear a certain load) has also been considerably decreased.

In the above tests all except two of the bars broke outside of the weld.

The change in deflection is much more marked than the change in strength. In all cases the deflection was lowered considerably.

It will be noted that all bars both before and after welding show a low strength and high deflection. This is due to the machining away of the stronger outer skin of the cast metal.

The bars 28 to 41 were quenched in water after being welded. This quench from the welding heat so hardened the bars that it was necessary to grind them to size for the second testing.

Table 3 shows the results of this treatment.

Table No. 3.

Breaking load (pounds)		Deflection (inches)	
Before welding	After welding	Before welding	After welding
2086	602	.143	.031

All these bars broke in weld.

Obviously this treatment results in almost ruination of the piece. In many cases cracks were visible in the specimen before being tested so that the strength of such pieces was very low.

Bars 42 to 51 inclusive were welded and allowed to air cool. The welds were then machined, the bars heated to 1200° F and quenched in water. The results are shown in Table No. 4.

Table No. 4.

	Breaking Load		Deflection	
	Before Welding	After Welding	Before Welding	After Welding
Average	2070	1813	.143	.107

Five bars broke in weld.

These bars show a decrease in strength after welding and heat treating. The deflection was also somewhat decreased by the treatment the bars received. The only notable change seen in this part of the investigation was in the number of bars that broke in the weld. This gave an opportunity to observe the interior of the weld. Most of the welds showed holes in the interior. It might be imagined that those with holes would naturally break in the weld but when investigating this by machining welds from bars that had broken outside the weld, similar cavities were found.

The effect of similar heat treatment upon bars of the same size, machined in the same way but not welded, is given in Table No. 4a, below. These bars had essentially the same chemical composition as the other bars.

Table No. 4a.

No treatment		Heated to 1200° F. and quenched in water	
Breaking Load	Flexure	Breaking Load	Flexure
2070	.144	1957	.155

This it may be seen that heating to 1200° F. and quenching in water causes a decrease in the strength whether welded or unwelded, although the welded bars showed a somewhat greater decrease in strength and deflection than the unwelded ones.

Bars numbered 52 to 61 were welded, air cooled and then reheated to 1400° F. and quenched in water. The result is shown on Table No. 5.

Table No. 5.

	Breaking Load		Deflection	
	Before Welding	After Welding	Before Welding	After Welding
Average	2263 ± 231	2450 ± 183	.152	.156

All except one of the bars broke in the weld.

From the table it may be seen that the average strength of the bars was increased nearly 200 pounds and that the probable error in the case of the bars tested after being welded is smaller than before welding. However, the results for the probable error in both cases is greater than those in Table No. 2. This is because many more bars were examined and entered into the results of Table No. 2 than did for Table No. 5. The probable error figures for Tables No. 2 and 5 are then not comparable with each other but the results in each table are comparable. It would appear then that the specimens were more dependable as represented by their average strength after they had been welded than they were before they had been

welded. If the treatment has been correct and the weld has been skillfully made, this is what should be expected, since in the first testing the bar broke in its weakest point. If this weak point can be repaired by welding without causing weakening at another point then the bar should be stronger when tested the second time. This treatment then seems to restore in some measure the strength characteristics of the original bar to the welded bar. The deflection (which serves as an indication of the resistance to shock) is also very nearly the same before welding and after welding followed by this heat treatment.

Five similar bars were heat treated in the same way without being first broken and welded. The results are given below.

Table No. 5a.

No treatment		Heated to 1400° F. and quenched in water	
Breaking Load	Flexure	Breaking Load	Flexure
2070	.144	2100	.154

These results give further credence to the theory that the indicated thermal treatment affects very little the strength properties of the material since the breaking load of the treated and untreated bars are very little different. However, in the case of the welded bars the strength has actually been increased. This might be considered as due (1) to the relief of the cooling strains set up by the high temperature gradient existent at the time of welding; and (2) the removal of the "weakest point" by breaking welding and by a method of heat treatment which does not otherwise affect the strength of the material.

Bars numbered from 62 to 71 were welded, air cooled, machined, heated to 1600° F. and quenched in water. The result is shown in Table No. 6.

Table No. 6.

	Breaking Load		Deflection	
	Before Welding	After Welding	Before Welding	After Welding
Average	2178	515	.146	.025

It can be seen that heating to 1600° F. and quenching so weakens the weld that it becomes almost useless. The remarkable feature of these tests was the way in which the greater part of the welded bars broke. Instead of breaking entirely apart—as is usually the case with cast iron in the transverse test—most of these bars merely cracked across and did not separate. They still retained enough strength to stand handling.

Five similar bars were given the heat treatment described above without first being broken and welded in order to determine the effect of the heat treatment on the unwelded material. The results are given in Table No. 6a.

Table No. 6a.

No treatment		Heated to 1600° F. and quenched in water	
Breaking Load	Flexure	Breaking Load	Flexure
2070	.144	2128	.174

These bars show a rather substantial increase in strength over the untreated ones whose breaking load was 2041 pounds. However, the most marked change is in the flexure, which increased from .144 to .174. This increase in the strength of the unwelded bars might be accounted for by considering that a portion of the graphite has passed into the solid solution upon heating above the critical temperature and increases the pearlite content of the bars after the quench. The increase in the strength would then be due to the increase in the pearlite content of the metal and the increase in the flexure might be due to the reduction and segregation of the graphite deposits and the replacement of these areas by pearlite.

In the case of the welded bars this heat treatment decreased instead of improved the strength. This was probably due to the strains set up in the bars by the very rapid cooling from above the critical temperature of the two dissimilar metals in intimate contact. That is, the metal introduced during the process of welding will be different in composition than the ordinary metal of the bar; first, because it may not have been alike before it was deposited; and second, because the process of melting and depositing by the torch greatly changes the proportions of oxidizable constituents. Thus when a slightly oxidizing flame is used these easily oxidized constituents will be reduced in amount and when a slightly reducing flame is used the carbon content of the metal may be easily increased by the acetylene. If then the composition of the two materials is not the same (and there is reason to believe that it may be widely different), especially if the carbon content changes sharply between the two materials, then the strains set up by this rapid cooling might be great and might actually result in cracks. This effect of a steep carbon gradient on quenched case carbonized steel is well known as "stripping." Such a deleterious effect of this heat treatment might be overcome to a great extent if the bars had been maintained at the high temperature for a long time in order to permit the establishment of a more gradual carbon gradient.

The Effect of the Direction of Application of the Load With Respect to the Weld on the Measured Strength of the Weld.

Bars numbered from 72 to 82 were welded, air cooled and machined. They were then tested without further treatment. In this case, however, the beveled double V instead of being placed at top and bottom, was placed on the sides. The result is shown in Table No. 7.

Table No. 7.

	Breaking Load		Deflection	
	Before Welding	After Welding	Before Welding	After Welding
Average	2157	1995	.148	.109

80% of these bars broke in the weld.

A decrease in the strength of the bars before and after welding may again be noticed from these results. However, when the values are compared with those in Table No. 2, a very little difference in strength is noted. Outside of the fact that more of the bars broke very near the welded section in these last tests, the direction of application of the load with respect to the beveling seems to have little effect on the measured strength.

Survey of the Results of These Experiments.

At the quench from the welding heat great stresses were probably set up in the material due to the great difference in temperature along the bar and therefore, to the difference in the rate of cooling and also due to the difference in the amount of contraction of the different materials in intimate contact (the parent metal and the metal deposited).

The reheating to 1200° F. and subsequent quenching seemed to reduce the strength of the bars probably because it served only to increase the stresses beyond what they might have been in an air cooled piece. The treatment at this temperature (which is much below the critical temperature) did not assist in establishing a gradual carbon gradient nor in another way altering the structural composition of the piece.

The treatment at 1400° F. gave the best results. At this temperature both the parent metal and the deposited metal were above their transition temperatures (transition of pearlite to solid solution) and at this temperature the materials were

quite porous to gases. These two factors lent themselves to the establishment of a more gradual carbon gradient which in turn decreased the shearing stress at the weld due to the differences in the coefficients of expansion between the parent metal and the welding rod. This treatment then probably resulted in the relief of strains due to expansion differences and in a decrease in the shearing force by decreasing the carbon gradient and so changing the shear to a bending moment. At the same time, however, the treatment decreased some of these desirable effects by setting up stresses between the inside and the outside of the bar, due to the difference in the rate of cooling. The total effect, however, was desirable and improved the strength of the bars.

In general then we may account for the weakness of cast iron after welding (1) to the changes in structural composition, (2) to production of stresses by (a) differences in the rate of cooling (b) differences in the coefficient of expansion of the materials in contact. This assumes, of course, that there has been no fault in the making of the weld itself.

The differences in the structural composition may be adjusted by heating above the critical temperature and fixing the structure rapidly. This may not restore the original structure of the material but the differences iin the structure between the parent metal and the deposited metal may be reduced.

The differences in the rate of cooling may be overcome by controlled cooling in a furnace, that is, heating below the critical temperature and cooling slowly and uniformly.

The differences in the coefficients of expansion are due to the differences in the structural composition and may be adjusted by reducing this difference or by the use of a filler rod that is capable of undergoing plastic deformation at low temperatures without the production of large internal strains (e.g., bronze rod).

Concerning the Applicability of the Heat Treatment Process.

It may readily be seen that a method of rapid cooling is certainly not of universal application in the heat treatment of all welded cast iron shapes. Thus castings which have heavy sections and light sections would not cool evenly or at the same speed when quenched. Indeed, such quenching might destroy such shapes if it be attempted. Only where the ratio of the mass of the casting to the cooling surface is constant or varies continuously and quite slowly throughout the casting, can these quenching operations be used. Where this is not true careful annealing (regulated, uniform cooling) is the best remedy.

Summary.

Table No. 8 gives a summary of the tests on all of the welded bars.

Table No. 8.

Treatment of welds	Breaking Load: Before Welding	Breaking Load: After Welding	Breaking Load: Change	Deflection: Before Welding	Deflection: After Welding	Deflection: Change	Number of bars averaged
Air cooled and machined	2108	1964	— 144	.155	.116	—.039	27
Quenched from welding heat, ground to size	2086	602	—1484	.143	.031	—.112	15
Air cooled, machined, reheated to 1200° F., quenched	0270	1813	— 257	.143	.107	—.036	10
Air cooled, machined, reheated to 1400° F., quenched	2263	2450	+ 187	.152	.156	+.004	10
Air cooled, machined, reheated to 1600° F., quenched	2178	515	—1663	.146	.025	—.121	10
Air cooled, machined, tested on side	2157	1995	— 162	.148	.109	—.039	11

A consideration of the results of these experiments seems to indicate that:

1. The heat treatment of welded cast iron does improve the strength and resistance to shock (flexure) of the material, if the proper heat treatment is provided.

2. Rapid cooling of the welded piece from the welding temperature greatly reduces the strength of the material.

3. The direction of the force producing the bending moment—whether on the same side as the scarfing for the weld or whether at 90°—has little effect upon the strength of the material.

4. If the weld and the material next to the weld are of different composition, the rapid cooling of the specimen through the transformation temperatures results in a weakening of the specimen, due to the production of cooling strains.

5. The fusion of the welding rod by the oxy-acetylene torch is accompanied by a considerable change in chemical composition.

A TELEPHONE EXCHANGE IS ADDED TO WITHOUT INTERRUPTING SERVICE

The manually operated telephone switch board is passing away. In all the larger cities dial phones are being introduced. At the Eddy and Glenville Exchanges of the Ohio Bell Telephone Company in Cleveland, the alteration was being made. For the new type of board more room was needed, which, in this particular instance, meant that the existing building had to be added to.

How the addition could be made without interrupting service presented a problem, which at first thought seemed rather difficult

Where Noiseless Alterations Help Company Service

of solution. Actually it was not. If the existing framing were added to in the old manner, that is by riveting, the noise and confusion always attendant on the use of pneumatic hammers, would have seriously disrupted service. By Arc Welding, however, the connections were made without breaking into the routine of the exchange in any way. The welding was done by The Economy Electric Products Co., with Lincoln "Stable-Arc" welders.

The photograph shows very clearly the manner in which the bays were extended. It was not even necessary to break out the wall. A hole large enough to insert the floor beams was cut, the post bared and the welding done. It was simple, quiet and speedy.

Arc Welding for building structures is not new, of course, has been employed for some time past and has met with wide approval among architects and engineers, and the elimination of noise is a rather striking advantage over other methods.

INEXPENSIVE PREHEATING FURNACE

The construction of a home made preheating furnace from easily obtainable materials is described in a recent issue of *Power*. After removing the tubes from an old discarded steam boiler, a section 30 inches long is cut from one end. A blowpipe is made from a piece of 3-inch pipe and the blow line is led through the shell about six inches below the top edge. Plain clay is used for the filling.

The Heat Treatment of Welds

Although Heat Treatment Does Improve Results, the Necessity for It Can Usually Be Avoided by Adopting Correct Welding Procedure

By G. R. Brophy*

TO THE builders of welded structures the heat treatment of the weld holds great promise of improvement to physical properties. This probably results from the fact that during multiple bead welding the grain size of the first beads is greatly refined by the passage of the following arcs. A little reflection on this, however, will show that the temperatures reached during this reheating are very high and not to be practically attained during furnace heat, except at the cost of great distortion to the work.

The nature of the deposited metal, under ordinary conditions of welding, is such that these high temperatures must be reached in order to obtain any benefit. It is well known that steel castings require high temperatures and long heating to recrystallize completely, even though the metal is melted under more or less ideal conditions, and, since a weld is essentially a casting but usually made under highly oxidizing conditions, and having a large columnar grain structure, it is evident that the temperatures required for complete refinement should be far beyond practical furnace heating.

Experiment shows that, at temperatures below 1000 deg C even for extended periods of time, the average weld is not materially improved by annealing. The strength and hardness is usually reduced but there is not the desired gain in ductility, as measured both by elongation and reduction of area. The latter values are particularly low in all conditions.

A normalizing treatment, however, consisting of heating to from 950 to 1000 deg. C for from two to three hours (in the case of half-inch plates) followed by rapid air cooling, does increase both ductility and strength, but it is a question whether this gain is sufficient to justify the expense and the danger of distortion.

In multiple-bead welding—that is, where the deposit consists of a large number of beads—the ductility obtained by usual annealing is quite marked because of the very high normalizing heats during the welding operations.

The following test data illustrates these points:—

Kind of Steel	Condition	T.S.	Y.P.	Elong. Percent	Red. Area Percent
Tank—as welded		50,200	35,000	6	11.9
	normalized 950°, annealed 900°	40,800	.....	4	14
S. A. E. 1010—welded		53,350	37,500	4	8.6
	normalized 950°, annealed	44,500	34,900	12	20
.24 C Firebox—as welded		61,650	broke outside weld		
	normalized 950°, annealed	56,600	42,000	13	20
.28 C Tank—as welded		45,600	.....	6	4.6
	normalized 950°	64,600	.....	21	16
	annealed	49,000	.....	13.5	15
.21 C Firebox—as welded		59,000	38,000	12.5	14.5
	normalized	57,000	35,000	18	19.5
	annealed	50,650	26,200	15	21
.33 C Tank—as welded		45,600	.....	9	8
	normalized	65,000	.....	10	13
	normalized and annealed	48,400	.....	12	*16
	quench water 900° C	76,000	.....	7	5
Tank, ¾" plate, 6 beads—as welded		61,600	44,000	21	25
	annealed	57,000	42,000	26	35
	normalized	62,400	45,200	27	31.7

*Side of weld.

A second purpose of annealing is to relieve residual stress, which undoubtedly is complete. But, because of the red-shortness of oxidized metal and the differential volume changes during annealing this relief may take the form of fracture unless the heating is extremely slow. Numerous cases have been noticed where the welds have cracked during annealing. Also, as mentioned before, the danger of sagging with its own weight together with the relief of stress may cause the structure to warp badly at the high temperature.

Stress, however, may be thoroughly relieved, and brittleness due to the hardness may be reduced, by low-temperature annealing and without the danger of excessive warpage or fracture. Again, however, heating should be very slow and uniform and temperatures of 700 deg. C should not be exceeded.

A determination of these lock-up stresses by the Heyn method in flat plates one-half inch thick shows that, in the bead at a distance of approximately one-quarter inch from the center and in a zone parallel to the length of the bead, a tensional stress of 28,000 pounds per square inch occurs. Using the strip method developed by Anderson residual stresses of approximately 5000 pounds tending to bend the bead downwards were found. These stresses are the result of differential shrinkage between the deposit and the plate, caused by differences in temperature and specific contraction.

Upon heating a similarly welded plate for two hours at 700 deg. C and repeating the stress determination, no deflection was obtained, which indicates relief of stress.

The Role of Manganese and Carbon

With increasing carbon content in the deposited metal,—whether this carbon is derived from the metal welded or the metal electrode—the deposit becomes harder and stronger but, of course, more brittle. The presence of carbon tends to decrease the amount of oxide and nitride in the weld metal and yields a more normal steel. These higher carbon deposits recrystallize more completely, at lower temperatures and in a shorter time than do the low carbon deposits, and are therefore more susceptible to heat treatments.

For instance a 0.93 carbon steel electrode yielded a deposit containing 0.44 carbon. This weld, when heated to 850 deg. C for a half hour and cooled slowly, was found to have a normal pearlitic structure. No nitride needles were noticed and but few oxide spots. On the other hand, a deposit made with a 0.18 carbon electrode yielded a deposit containing 0.04 carbon and, after annealing at 90 deg. C for four hours, still showed a large columnar grain and contained numerous nitride needles and patches together with considerable oxide.

Manganese plays a rather important part in the protection of carbon during the passage of the metal from the electrode to the deposit. It apparently combines more rapidly with the oxygen of the surrounding atmosphere than does carbon, and, in doing so, allows the carbon to pass more completely into the weld.

The following table shows the analyes of several electrodes arranged according to increasing manganese content and the analyses of the deposits made with these wires.

	C	Mn	C	Mn	C	Mn	C	Mn	C	Mn
Electrode	.13	.45	.93	.45	.56	1.78	.74	4.97	.80	12.9
Deposit	.02	.13	.44	.30	.28	1.22	.44	4.06	.75	11.48
Loss	.11	.32	.49	.15	.28	.56	.30	.91	.05	1.42
% Loss	85	71	52.5	30	50	31.8	40	1.8	6	11

These results show that the amount of carbon lost during passage through the arc depends, first, upon the amount of carbon in the electrode and, secondly, upon the amount of manganese present. With high manganese contents practically no loss in carbon occurs. By plotting the above data and extrapolating, it

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is found that, presumably at 14 to 15% manganese no carbon would be lost, and that the maximum amount of manganese lost would remain at about 10% of the manganese in the electrode.

Manganese, undoubtedly, continues its good work in the deposit by deoxidizing and rendering gases more soluble and the metal more fluid, thereby preventing porosity. Hot shortness as a result will be decreased and greater safety from cracking will be obtained. The presence of manganese in the weld metal lowers the critical range and increases its susceptibility to heat treatment.

It is not to be construed that the writer is not in favor of annealing or other heat treatments of welds. The test data show that improvement does result but, if the proper welding conditions are maintained and the proper sequence of operations followed, welds of satisfactory strength and ductility will result and, for the ordinary uses, heat treatments will not be necessary. Stress may be eliminated, or at least minimized, by proper welding procedure, and in order to insure against the presence of any residual stress a low temperature anneal will accomplish equally as much as a full anneal.

The presence of carbon in the weld tends to eliminate embrittling nitrides and oxides, and aids in the grain refinement during heat treatment. Managanese also aids in grain refinement directly, by its presence in the deposit, and indirectly by its protection to the metal and carbon during the passage through the arc.

The measurement of residual or locked up stress in welds is at present being studied to a greater extent.

PRESSURE VESSEL WELDING

An imposing array of succesful accomplishments in the field of presure vessel welding by the oxy-acetylene process was described by Mr. A. O. Miller, Vice-President of Reeves Bros. Company, Alliance, Ohio, in a paper read before the annual meeting of the American Welding Society at New York City in April. The work which the Alliance firm has already done has shown marked advantages over riveted construction, even in the matter of safety, and has led to more extensive applications of the torch in this field work which Mr. Miller barely had time to mention. Their present operations, however, are expected to pave the way for the use of welding on vessels which have heretofore been riveted or hammer welded.

In the year 1922 Mr. Miller's organization built by oxy-acetylene welding a rotary lime kiln 8 ft. in diameter by 125 ft. long of 5/8 in. plate, a piece of equipment which up to that time had always been made of riveted construction. The details of its construction attracted considerable attention through technical publications. At approximately the same time they built three rotary coolers 5 ft. in diameter by 50 ft. long of 3/8 in. plate. After four years of continuous operation it is reported that all of these have given entire satisfaction.

At the time of this undertaking an experimental section of a kiln 24 ft. long was built in order to try out methods of welding and procedure and later two heads were made and these were welded to the experimental section, forming a cylindrical tank with dished ends. This assembly was subjected to a hydraulic test, and the pressure increased until one of the first welds made gave way for a distance of 2 in., but not before the tank had stretched in length about 2¼ in. and about 2⅛ in. in circumference. This proved to us the correctness of the procedure used.

Several 7 ft. in diameter by 35 ft. long storage tanks were then attempted. These were for 125 lb. working pressure and ¾ in. plate of fire box quality was specified for the shell. Heads were designed in accordance with A. S. M. E. Boiler Code design formula, 1¼ in. thick, one head being equipped with a standard boiler manhead frame, the design fiber stress being 7,000 lb. These tanks were tested to 125 lb. pressure, then raised to 250 lb., at which pressure all seams were hammered every 2 in. with an 8-lb. maul. The pressure was then finally raised to 375 lb. and held for three minutes. All seams throughout were double vee oxy-acetylene welded, nickel steel rod being used. Welders were requird to show on test welds at least 45,000 lb. tensile strength.

Three additional tanks were built of the same thickness and for the same pressure, then four more of 11/16 in. plate in shell for same pressure, the design fiber stress being 7,650 lb. Three of the 5/8 in. plate were also built, the design fiber stress being 8,400 lb. These held up very satisfactorily on the tests.

The next job was a tank 5 ft. in diameter by 43 ft. long of 1⅛ in. plate in shell, designed on 8,000 fiber stress in material at working pressure of 300 lb., using a standard A. S. M. E. boiler manhead in one of the heads. On completion of the tank, it was first given the regular hydrostatic test applied on all welded vessels constructed previously. This consisted in applying a pressure of 600 lb. (twice the design working pressure) and hammering all welded seams with a 10-lb. sledge. The pressure was then increased to 900 lb. (three times the design working pressure). The fiber stress at this pressure was 24,000 lb. As it was felt that 9,000 lb. fiber stress could safely be used it was decided to increase the final test to 1,000 lb. pressure or the equivalent of three times the working pressure based on the higher design stress. This pressure was applied and strain gage measurements indicated particularly high stress around the head knuckles and manhole, especially the manhole. On the second application of the 1,000 lb. test pressure considerable distortion took place around the manhole and it was therefore decided to continue the test until no further permanent set occurred at test pressure or if necessary to destruction. On the third test the head failed through the manhole at 930 lb. pressure.

An examination of the ruptured head proved conclusively that the welds were in no way responsible for the failure, as they were all intact, except as severed cross-sectionally together with the saddle plate and head. On the other hand, the failure proved much in favor of the welded joint, the head girth weld and the longitudinal weld in the course adjacent to the manhead being in no way affected.

This test has been described fully in papers before a joint meeting of The American Society of Mechanical Engineers and The American Welding Society, and also in issues of "Mechanical Engineering."

The fractured head of this tank was cut off and replaced with a new head, and new type of manhole made from a solid 5-in. slab turned down on the edges so that same could be welded into head. The success of this job demonstrated that the old A. S. M. E. riveted type design of manhole was not sufficient to withstand the higher tests that were being applied on welded vessels, namely, three times the working pressure.

Later constructions include: a number of smaller units for pressure up to 150 lb.; three oxygen receivers 6 ft. x 24 ft. of 1 in. plate for 250 lb. pressure designed for 9,000 lb. fiber stress; nineteen 7 ft. x 35 ft. tanks of 13/16 in. plate in the shell for 200 lb. working pressure, with the new design manhole; a retort for 250 lb. working pressure; a reuping tank for 125 lb. working pressure; two air receivers for 325 lb. working pressure; a scale tank for 250 lb. working pressure; six oxygen receiver of 1¼ in. plate for 300 lb. working pressure, design fiber stress of 9,000 lb.; two creosoting retorts 90 in. in diameter x 90 ft. long for 200 lb. working pressure; three pressure measuring tanks 90 in. x 90 ft. high; one reuping tank 90 in. x 55 ft. long; two vapor drums 5 ft. x 16 ft. long.

Mr. Miller's experience has demonstrated that it is possible to build pressure vessels by oxy-acetylene welding, without extraordinary precautions, which will be greatly superior from a service standpoint to riveted construction, and have a safety factor at least twice as great.

WELDING OF HEADER FOR HEATING SYSTEM SAVES OWNER $85.00

The cost of a header, six feet long and eight inches in diameter, required for the heating plant of an apartment building, was estimated at $106.90 if made in the usual way (figuring pipe,

flanges, nipples and fittings at net wholesale cost.) It was decided to weld the header, utilizing scrap lengths for the risers and outlet, the total cost for material, gas and labor amounting to only $19.55, a saving of over $85.00 under the cost of a header made up with standard screwed fittings.

The outlet at the bottom was two inches in diameter, two of

Ninety Minutes for This Job

the risers three inches and the other three risers two and a half inches. The total time required for all cutting and welding was only ninety minutes. The work was done by the Minneapolis Welding and Manufacturing Co., using a Smith's No. 64 welding tip.

LINCOLN ARC WELDING CONTEST PRIZES AWARDED AT SPRING MEETING OF A. S. M. E.

At the opening session of the spring meeting of the American Society of Mechanical Engineers, held at the William Penn Hotel, Pittsburgh, May 14th, prizes were awarded to the winners of the Lincoln Arc Welding Contest.

James W. Owens, director of welding for the Newport News Shipbuilding & Drydock Company at Newport News, Va., won the first prize of $10,000. Owens is a past vice-president of the

James W. Owens

American Welding Society and a fellow of the American Institute of Electrical Engineers. He is also author of the text book, "Fundamentals of Welding."

The award for the second best paper submitted, $5,000, was won by Henri Dustin, Professor in the Engineering School of the University of Brussels, Belgium and Director of the Laboratory for Material Testing. Third place award, $2,500, was given to Commander H. E. Rossell, Construction Corps, United States Navy, instructor of mathematics at the U. S. Naval Academy at Annapolis.

Seventy-seven papers were submitted in competition for the prizes, of these thirteen were entered by residents of foreign countries. The little country of Belgium was represented by the most entrants of any foreign country, England ranking second.

The task of ferreting out the most deserving papers was a stupendous one for the judges. Sixty-six papers were rejected after the first reading and the remaining eleven reread by each of the judges. The final selection was determined by letter ballot. The Owens' paper, "Arc Welding, Its Fundamentals and Economics," received a unanimous vote for first prize.

Mr. Owens explained his paper's title as "a treatise on the fundamentals or arc-welded design and shop practice, and an analysis of its industrial application and world wide possibilities." He divided his treatise into eight sections and an appendix, which are titled as follows:

I. The Advantages of Arc Welding.
II. A Brief Outline of the Fundamentals of Design and Shop Practice Necessary to Insure the Extensive Economic Use of Arc Welding.
III. A Discussion of the Principal Stock Objections to the Use of Arc Welding.
IV. A Description of Some Recent Outstanding Applications of Arc Welding.
V. Comparative Riveted and Welded Designs of a Large Freight Ship.
VI. The Relative Weight, Cost and Economy of Riveted and Welded Ships.
VII. Effect of the Full Utilization of Arc Welding on Shipyards and on Industry in the United States.
VIII. Summary and Conclusions.

APPENDIX—Arc Welding Definitions, Nomenclature, Symbols, Weld Gages, Design Data, Fundamental Specifications, Tentative Standards for Ship's Hulls and Machinery, List of Arc Welding Applications to Ship's Hulls and Machinery, Miscellaneous Illustrations.

Over one hundred photographs, charts, tables and drawings illustrated the text matter.

Prof. Dustin's prize money paper deals with the strains set up in welded joints and methods of calculating such strains. The Belgian contributed much basic information which will be very valuable for use in the preparation of handbook data. Research work in South America prevented the professor from attending the awarding of the prizes.

E. B. Rossell, brother of the prize winning commander, received the third place award for his brother. Commander Rossell entitled his contribution, "Electric Welding of Ships' Bulkheads and Similar Plated Structures." He devoted over 100 pages to his profusely illustrated text and supplemented it with a large number of comprehensive tables and charts. The manner in which the naval officer handled his subject indicated extensive research and intelligent study.

WELDING LEAD

The main point in welding lead successfully, says a writer in *Oxy-Acetylene Tips*, is to clean the surface so that thorough fusion will result. The melting point of the metal is so low that only a very small flame is required, and this should have a slight excess of acetylene. The torch is held so that the flame is almost perpendicular to the work and with the inner cone almost touching the surface of the metal. As soon as the metal melts the flame is lifted to prevent excess melting. When a lead filler rod is used the flame should be played simultaneously on the rod and along the edges of the work to be welded so that they will reach the fusion point at the same time. Thorough fusion is necessary in order that the welded joint may be absolutely tight. Lapped sheets should be hammered tight and welded using filler rod.

BRAZING IN ATMOSPHERE OF GAS

By the use of atmospheres of protective gas in electric furnaces, steel parts used in the manufacture of complicated assemblies can now be conveniently united by a strong alloy weld which would be exceedingly difficult to accomplish by other means, according to an announcement by the General Electric Company. This method, known as hydrogen brazing, involves the welding together of the parts to be joined by means of a copper flux.

This process of copper brazing, while not new, has heretofore been attended by a number of practical difficulties in application. Marked improvements in the equipment used are now announced by the General Electric Company, in whose laboratories considerable development work has been going on for a number of years. As a result, the method may now be applied successfully to many operations with resulting simplification of method and reduction of overall costs.

Electric furnaces of small size, utilizing protective atmospheres, have been used in laboratories for brazing by this method for some years. An early and important use was the manufacture of steel shafts for golf clubs. The advantages of the process were quickly recognized, and a gradual development of suitable equipment followed.

The theory of the process involves the reducing action of a hydrogenated atmosphere, which thoroughly cleans the surfaces to be joined, and the capillary attraction of the fluid copper, causing it to diffuse quite generally over the surface and to be drawn into the minutest joints between the parts. The protective atmosphere is essential during the cooling portion of the cycle also, and for this reason the usual type of furnace cannot be used.

A typical hydrogen brazing furnace used in the Schenectady plant of the General Electric Company consists of three "stages." Each stage is in the form of a platform. Covers which may be raised and lowered are provided for two of the stages. The work to be brazed is first assembled on one stage, copper wire or chips being placed adjacent to the joints to be united. The assembly is then placed in the heating chamber at a suitable temperature, and the next stage loaded. When the first assembly has been suitably heated over a predetermined period of time, it is withdrawn from the heating chamber and placed in a cooling chamber, the second assembly automatically moving into the heating chamber. Thus the heating, cooling and assembly may take place at the same time.

Another application on which the protective gas envelope is used to advantage is bright annealing steel in sheet or fabricated form, for nickel, monel and certain other non-ferrous metals, to save the cost of annealing pots, handling, pickling, etc. In such work, a furnace of the continuous type is used, designed for larger output. The work is loaded on suitable trays arranged to be pushed through the furnace on a roller track. An elevator raises the trays into the furnace at the entrance end and a similar elevator is used to remove them from the discharge end. A hydraulic cylinder is used to push the work through the furnace. Heating takes place in only one portion of the furnace, the remainder being provided with a water jacket for cooling; thus the work is both heated and cooled in the protective gas atmosphere.

SCHOOL OF COMMERCIAL WELDING

Located at 7421 South Alameda Street, Los Angeles, California, is a school for welders conducted in a manner quite out of the usual routine for trade schools.

This school which teaches both Electric Arc and Acetylene Welding and Cutting was established by "Tom the Welder" and varies from other trade schools principally because the students are taught from the very first operations just what will be expected of them in the field. For example the first welding job they are given, and the instruction is all practical under the direct supervision of expert welders, is given them with specific limits of both character of weld and time for the welding operation so that as soon as they have perfected the operation to the required limits they are assured of their ability to perform such a weld worthy of commendation in the commercial field. Pipe line welding, for example, has established certain time limits for each of the many welding operations and students in this welding school are taught to weld pipe under field conditions and in the time limits set in field practise.

Such a method of instruction has proven its advantage in many ways but its one great benefit to the student is the

"Tom the Welder's" School

endowment of courage and self assurance. As the student advances and becomes more or less proficient in welding under the various conditions and on the various types of materials, he is taught the jargon of a welder and is told what to do and what not to do under this and that condition. He is shown the contrast in behavior between the average novice and the experienced welder and while the student may or may not grasp the significance of this sort of coaching, as soon as he gets in the field and finds that his work is identical with the work on which he has been trained and is proficient, the student has the confidence of the older hand and turns out work of equivalent merit to the older hand. In a word, these students are taught to be practical welders under the very same conditions they would find in any commercial welding shop but have the advantage of expert instruction to guide and train them as they practise.

The equipment in the school consists of 12 individual benches each equipped with a high grade welding torch and individual acetylene and oxygen bottles and gauge equipment. There is one gas cutting outfit, and the Arc Welding Department has four welding booths with all the necessary equipment for commercial electric-arc welding.

The courses and prices for each are as follows:

Acetylene—32 hours, 2 to 6 tip	$	65.00
52 hours, 2 to 6 tip		95.00
72 hours, 2 to 8 tip		125.00
Electric Arc—32 hours	$	45.00
52 hours		75.00
72 hours		105.00

The school sessions are 10:00 A. M. to 12:00 M.; 1:30 P. M. to 3:30 P. M. Evening session, 7:00 P. M. to 9:00 P. M.

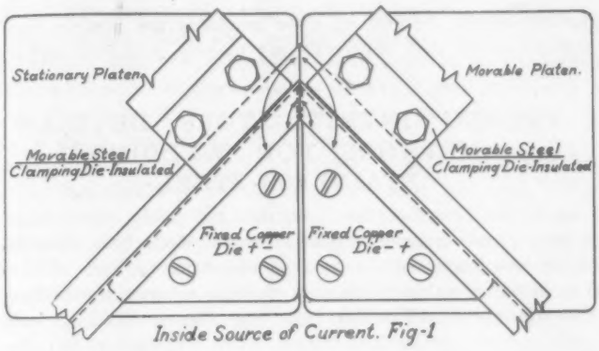
The acetylene equipment is Oxweld throughout; in the arc welding department there are two Westinghouse machines, one Fuzon portable machine, and arrangements have been made to install one General Electric machine. Preparations are also being made to install a spot and butt welder so that welding in all its branches may be taught. Every student upon entering the gas department is given a pair of Carter-Lockard Goggles.

Improving the Miter Weld

New Types of Resistance Welders Are Designed to Produce Miter Welds Meeting Exacting Requirements of Maufacturning Plants

WHEN structural shapes came into use occasion arose to join them on the miter. This was accomplished at first by shearing them on the miter and riveting them to corner plates. Later they were gas or electric arc welded after shearing.

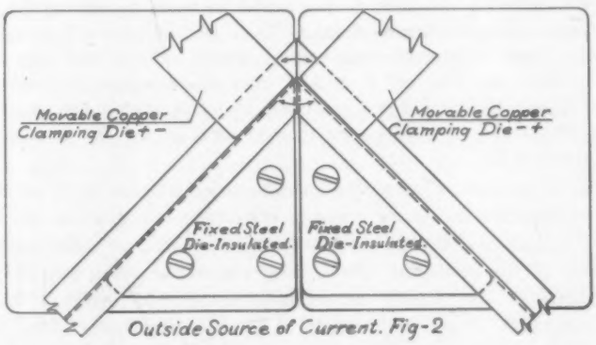
The desire for mass production of miter welds forced the problem to the attention of manufacturers of resistance butt



Inside Source of Current. Fig-1

welders and attempts were made to make a satisfactory miter welder. Machines were constructed, some of which made but one weld at a time and were frequently called "corner welders": while still other machines were known as "four-way welders."

Both types of welders found application to the manufacture of steel sash, automobile doors, wind-shield trimming, and many similar uses. The welds made by these machines, while



Outside Source of Current. Fig-2

more or less satisfactory for the purpose, were not, however up to the standard recognized for straight butt welding jobs. In many operations, while the welds were strong enough, too much material was thrown up at the weld which had to be chiseled or ground off, making it both bothersome and costly, and in other operations the welds were none too strong. In many cases the weld was not uniform throughout its length.

It became recognized that the difficulty, where difficulty was encountered, lay largely in the method of applying the current to the weld. Usually the electrode dies were placed on the inside of the work as shown in Figure No-1. The work was held against the electrodes by movable steel clamping dies from the outside. Ordinarily the clamping dies were prevented from carrying current. A glance at the arrows in Fig. 1, shows that the welding line presents very unequal paths for the current to travel. The result is that the weld receives too much current on the inside and not enough travels out to the point, the major portion of the flow, naturally taking the shorter path.

All of these objections can be overcome, if as in Fig. 2, the inside dies are made fixed, preferably of steel and insulated and the movable copper clamping dies are placed on the outside, and are made to act also as the electrodes. It is evident with this arrangement, that the current will take a path shown by the arrows in Fig. 2. This method subjects the entire welding line to a uniform flow of current, with consequent even heating, and uniform welding. Only with uniform heat can a good weld with small upset be hoped for.

The Federal Machine & Welder Company recently developed

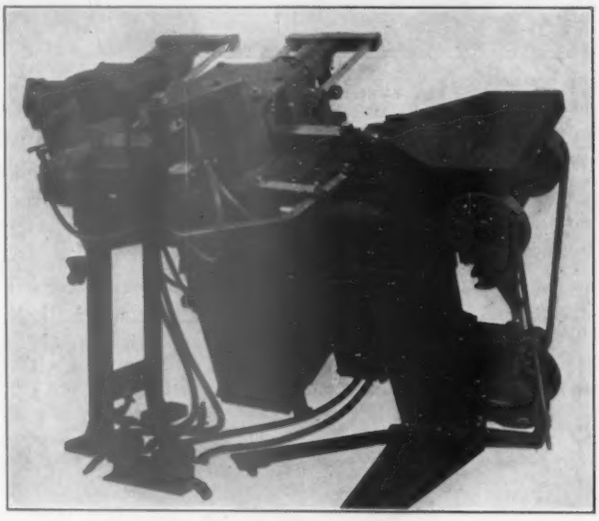


Fig. 3—Automatic Butt Welder for Making Miter Welds

the Type No. 60 Automatic Butt-Welder shown in Fig. 3, which embodies the above principles. The machine embodying the Federal "Flash Proof" principle is equipped with a 65 K. W. transformer, and an auto coil which provides 60 per cent voltage regulation. This machine is adapted to miter welding of steel sash and similar construction. The clamping and releasing of the work as well as starting of the motor is done by means of the respective foot levers. A mechanical brake stops all motion at the end of the welding cycle. As built, the welder will weld about one inch cross section. The machine can be adapted to larger sections by increasing the transformer capacity. As geared this machine requires seven seconds for the welding cycle. To this time, time for clamping and releasing the work must be added. In practice an average welding speed of 240 welds per hour is attained. This will vary with the kind of work and the kind of jigs used to hold the work.

The clamping is done by air at 80 pounds pressure acting through liberally proportioned cylinders. The flash and push up operation is produced by a cam, motor driven through the medium of a worm gear reduction. The motor is controlled by an electro magnet across the line type starter. Depressing the lever to the right causes the motor to start, which continues till the welding cycle is completed.

The advantage of the motor driven flash and push up

mechanism and the air operated clamping devices is that it relieves the operator from physical strain and thereby enables him to turn out more product.

A view of the stationary and movable dies is shown in Fig.

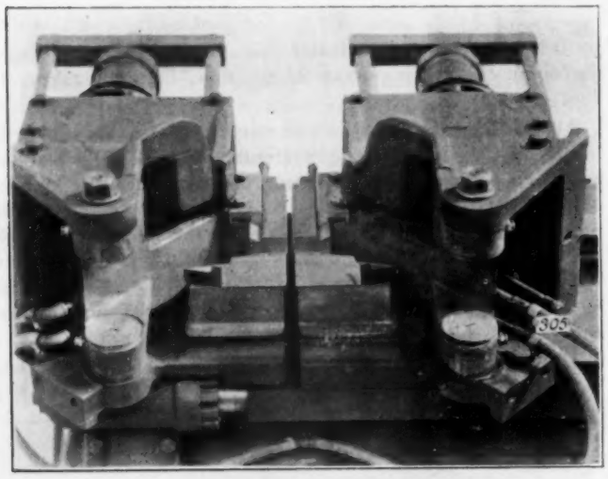


Fig. 4—Stationary and Movable Dies

4. All gibbed and sliding members have been done away with, it having been found in practice that they will not stand the severe conditions imposed upon them. The movable dies are carried on hinged members and the fulcrum points are well beyond the flashing zone.

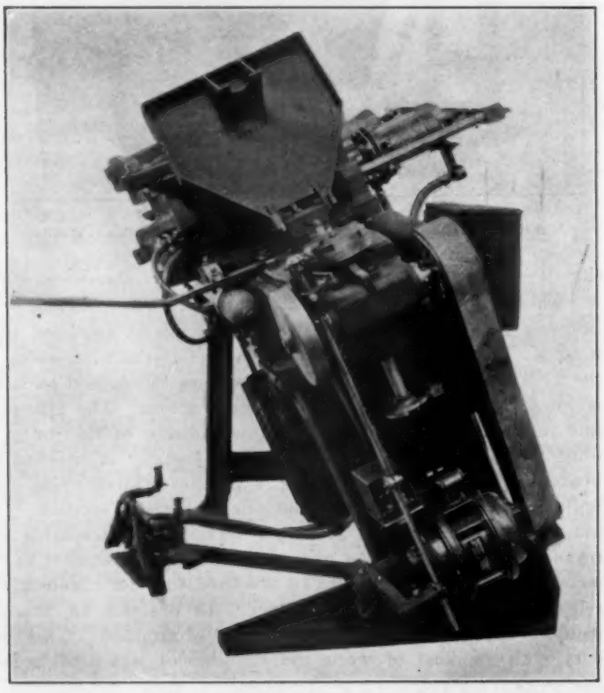


Fig. 5—Machine Constructed on an Angle to Hold Work Horizontal

As the outside movable electrodes operate in a plane making considerable angle with the inside dies, it is necessary to construct the machine on an angle as shown in end view, Fig. 5. This is done so the work can be held in a horizontal plane while welding. This is very desirable when welding long sash.

The weld shown in Fig. 6 is a perfect weld, as flash welds are known. It has a very thin upset which can easily be chiseled away. The forging and welding action has been perfect, and it is just the type of weld that those interested in pro-

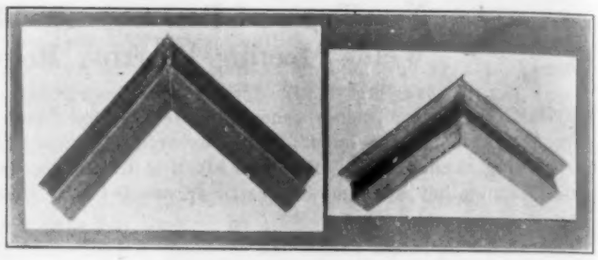


Fig. 6—Example of Miter Welds. Note Thin Upset

duction desire. Several of these machines are now in regular production and they apparently are meeting with full approval.

FRENCH INVESTIGATORS DEVELOP METHODS FOR WELDING STAINLESS STEEL

In a recent issue of the *Revue de La Soudure Autogene* there is an interesting report of experiments which have been made in the laboratories of the welding association in Paris with various kinds of corrosion-resisting steels in common use in France, the principal classifications being the chrome irons, chromium steels and the chrome nickel steels. The investigators have noted that the principal difficulty encountered has been caused by the chromium oxide which is formed just as soon as any of these alloys are brought to the fusion point under the welding flame. Other experiments indicated that a portion of the welding difficulties were overcome by using a slight excess of acetylene in the flame so as to be protected against the possibility of oxidizing the weld more than is necessary. They point out, however, that the important factor in successful welding of these alloys is the use of the right kind of flux and using it in the right manner. After trying a number of different combinations it was finally found that a satisfactory flux could be made by mixing borax, boric acid and silicate of soda. Their method of use is to apply the liquid silicate of soda to the reverse side of the weld and sprinkle the flux on it thickly; they also moisten the welding rod with the same liquid and cover it thickly with a flux powder. This makes it unnecessary to stop welding for the purpose of applying flux.

On account of the of the characteristics of these alloys at high temperature, they have found it advisable to bevel sheets of over 5/16 inch thickness so as to avoid the formation of large puddles and at the same time assure good penetration. The packing of sheets is also worthy of attention because so many of these chromium alloys are fragile at high temperatures. On the thicker sheets best results have been obtained by making the weld in several layers so as to keep down the size of the puddle. Best results have also been obtained by advancing the torch in a perfectly straight line without circular or wavy motions and holding the end of the welding rod close to the puddle and under the protection of the reducing envelope of the flame. Special attention is given to making sure that the edges to be welded are fused all the way through the sheet before adding new metal from the welding rod, the added material being supplied a little at a time. If the work happens to be interrupted there will usually be a hole left where the interruption occurs. This must be carefully filled up by starting welding again a little behind the hole and using a little extra flux at this point on account of the extra amount of filler rod that is added. A number of experimental welds have been made which have shown very satisfactory qualities, and further investigations and experiments are being conducted at the present time.

Welding and the Engineer*

A Survey of Oxy-Acetylene Welding and Cutting Processes Which Are of Particular Interest to Civil Engineers

By C. A. Daley†

IN our modern construction steel plays an important role. You can see everywhere about you steel replacing wood construction. Our ships, our bridges, our buildings, and even our furniture are now being constructed of steel. Is it little wonder, then, that the oxyacetylene welding and cutting torches have come into common use?

The carpenter has his saws, planes, chisels, hammers, nails, et cetera, for working and joining wood, but the working of steel by the older conventional methods requires an altogether different set of tools, the operation of which generally involves heavy machinery and power. This limits the preparation of steel work in large degree to a shop.

The invention of the oxyacetylene cutting and welding torches has furnished the steel worker with his most useful modern tools. They are light and portable and may be used anywhere. If a heavy plate, I-beam, or other heavy section has to be cut, the torch can be easily taken to the job instead of taking the job to a stationary machine which would involve the use of a crane or some other means of transportation.

Oxyacetylene Welding and Cutting as Applied to Railroad Maintenance

In railroad maintenance the oxyacetylene torch plays an important part to reduce maintenance expense. One tune the maintenance engineer always hears is "Keep expenses down." Here, the torch is his friend.

A 130-pound section rail in place in the track is worth approximately $40. You can readily appreciate the expense a maintenance engineer must provide for in his budget to take care of this single item. Then, too, there are the numerous crossings, frogs, and switches which must be provided for. Naturally, therefore, he is interested in getting the longest possible life out of these costly materials, consistent with safety and good riding track.

When rail ends begin to batter, maintenance expense begins to mount. The battered ends cause excessive wear in the bolt and angle bars, loose joints, shattered ties, and rough riding track. Even the ballast is dislodged by the hammering of the wheels as they pass over the battered joints. This bad condition must be looked after frequently by the section men. Bolts must be tightened, angle bars renewed if worn or broken, and the joints tamped up, or even worse conditions, such as wide gauge and poor alignment, will develop.

The first all-iron rail used in this country was on the Camden-Amboy Railroad in 1848. This rail, 7 inches high, had a base 4⅝ inches wide. It was thought at the time that the rail problem had been solved as it was apparently a distinct improvement over the iron topped wooden rail, but it was soon found that the rail battered very badly at the ends, and this in turn caused considerable shock and damage to the rolling equipment. After a year or so these rails were replaced with the old iron topped wooden rails.

This was the first instance of rail batter, a problem which today confronts railroad engineers everywhere. In 1848 they took the rails out, but today, with the aid of the welding torch, battered rails are being built up in the track at small cost without interruption of traffic.

To illustrate the value of the welding torch in building up battered rail ends, suppose a battered joint has developed in a track laid with 130-pound rails and it is desired to correct the bad condition. If no welding torch were available, it would be necessary to replace two rails. These rails, as mentioned before, are worth in place approximately $40 a piece. Therefore, it would require an $80 outlay to repair the bad condition. Of course the rails removed have a small salvage value, but it is only small compared to the $80 expenditure.

With a welding torch and special welding rod suitable for this work, a battered joint can be built up for approximately $1.50, and the repaired rail ends will be better than when new, that is, they will stand more traffic.

The operation of building up battered rail ends is not difficult, and it can be done in the track, as before stated, without interfering with traffic. The joint to be built up is surfaced to the proper elevation by the section men and new bolts and angle bars are applied where necessary. The welder determines the amount of metal to be added and the distance the weld must be carried back by placing a short straight edge on top of the rail. He takes his torch and melts out all the loose and fatigued metal. The torch is then directed upon the end of the rail and when the metal has been brought to a molten condition the special welding rod is added, working in both directions until sufficient metal is added to eliminate the batter and bring the rail surface up to the common level. If the rails are close together, the weld can be carried across the joint and then the weld metal can be cut at the joint with a hot chisel. The whole weld is then heated and given a final smoothing with a blacksmith's flatter.

Frog Welding

Frog welding like rail end welding may also be done in traffic. A No. 10-100-pound open hearth rigid frog costs approximately $125. This frog when worn to the joint of replacement can be built up by the oxyacetylene process for what it would cost in labor alone to replace it with a new frog.

A frog that has been given ordinary maintenance attention, that is one in which the bolts have been kept tight so that the fillers and bolt holes are in good shape, can be rewelded several times. Thus, with a welding torch available, the number of frogs carried in stock for renewals can be materially reduced.

Switch Point Welding

The switch point unlike other parts of the track structure presents only a thin fin of metal to withstand the shocks and abrasive effects of car and engine wheels. Epecially is this true of the deflecting point.

A switch point built up against a worn stock rail will outwear by far a new point in the same location for the reason that the built-up point will have the same contours and height as the worn stock rail whereas a new switch point applied against a worn stock rail does not conform and will as a result soon be ruined.

It costs about $5 to rebuild a worn switch point while a new 100-pound point costs approximately $25. It costs more for labor to install a new point than to build up the average worn point.

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*Paper read at joint meeting American Society of Civil Engineers and American Welding Society, New York, March 21, 1928.

†Maintenance of Way Engineer, Air Reduction Sales Co., New York.

Welding Rails Together

In constructing tracks through and across streets and highways it is desirable to eliminate as many joints as possible in the traveled way because these are a source of trouble from a maintenance standpoint. Special long lengths of rails can be obtained for this purpose, but they are costly and hard to handle, and when you want one badly at one location it is generally somewhere else.

Here again welding and cutting torches are indispensable for efficient low cost track maintenance. The ordinary length rails can be welded together and the angle bars replaced making the rail continuous.

To make rail welds the rails are veed with the cutting torch across the bottom of the base, up the web, and on both sides of the ball in toward the center. Angle bars are then applied to insure proper alignment of the rails and are kept on until the weld is completed across the base. The angle bars are then removed and the weld completed, working from the bottom of the web up. When the weld has cooled sufficiently the angle bars should be reapplied and fully bolted. As many rails as desired can be welded into one continuous member in this manner.

Track Bonding

The most essential thing in automatic signaling and train control is a good track circuit. If bonding is poor, trains will be delayed, and battery consumption will be excessive.

The wire bond was used exclusively in bonding rails for automatic train signaling until a few years ago. Now, the fusion bond is rapidly replacing the old wire bond. The advantages of a fusion bond over a wire bond are as follows:

The welded bond is shorter than the wire bond and, therefore, affords greater protection. With the wire bond, a rail could be broken at the end of the angle bars or the whole head of the rail within the limits of the angle bar could be broken out and yet the track circuit would be intact and a clear signal indication given. With the welded bond applied to the head of the rail and at the very ends of the rail, complete protection is afforded.

The resistance of a welded bond is about 1/90 of that of the common wire bond. Therefore, battery consumption is materially reduced, resulting in savings ranging from $35 to $90 per mile of track per year. The cost of the two types of bonds, wire and welded, is about the same when in place.

The operation of applying welded bonds is as follows: A man goes ahead of the welder and places the bonds on the outside of the head of the rail over the angle bar. The bonds are held in place by a simple but cleverly constructed holder made from a piece of welding rod.

The welder first heats and tins the rail at the point where the bond is to be applied. He then proceeds to weld the copper bond to the steel rail using a flux and rod designed especially for this purpose. A good welder will apply an average of thirty-five bonds per hour.

Structural Steel Cutting

The cutting torch is especially valuable in the structural steel fabricating shop. It is to the steel worker what the hand saw is to the carpenter. No steel beam, channel, angle or plate is too big or too small for this tool, and torch cutting is not limited to straight or square cuts. Circular, beveled and angular cuts are made with facility.

Automatic cutting machines have been developed for cutting irregular shapes from plates and for cutting angles, I beams, and other rolled forms. I refer to the Oxygraph and Radiagraph. Precise cutting can be done with these machines comparable in accuracy to roughing cuts made by machine tools. Automatic welding machines also have been developed to produce steel sections impracticable to roll.

Some time ago one of our servicemen was called upon to do some cutting in connection with the reconstruction of a large steel frame building to which several stories had been added. The new steel work was tied in with the old steel structure and it was necessary to change the supporting columns of the old structure and transfer the load to the new columns.

The foreman in charge of the steel work pointed out the cross beams and braces to be cut. He knew that these members were heavily stressed and thought that by cutting them first it would make easier removal of the old columns. But our servicemen after looking the situation over, suggested cutting through the supporting columns first, gradually shifting the load to the new supports. This could be done readily as the kerf cut with the torch is less than ⅛ of an inch, and as many cuts could be made side by side as necessary to release the load. This method was carried out, and after the old columns were relieved of the load all the braces and cross beams were cut without difficulty.

This is one instance where the cutting torch served also the purpose of a number of jacks.

Cutting Under Air Pressure

One of the greatest engineering achievements of recent years is the newly opened Holland Tunnel. Its successful completion is a monument to the engineering profession. The maintenance and operation of the tunnel after its completion involves more engineering than the average person realizes.

Even in this marvelous piece of work the welding and cutting torches played their parts and played them well. The shells of the cutting shields used in the construction of this tunnel were 30 feet in diameter and were made of riveted joint plate sections. The inside of each riveted joint was made air tight by welding. The shields were reinforced with heavy cross beams, braces, and cast steel members.

In order to start these shields it was necessary to make openings in the sides of the steel caissons which had been sunk off the ends of the piers on both the New York and New Jersey sides. The task of making these large openings 30 feet in diameter in the caissons 30 feet under the bottom of the river was accomplished with the aid of the oxy-acetylene cutting torch. Then the 30-foot circular sections taken from the sides of the caissons had to be cut up so that they could be removed from the air locks.

When the headings met in the center of the rivet, the shells of the shields were left in place, but all the crosses, beams, braces and so forth, had to be removed. These also were removed with the aid of the cutting torch. Most of this cutting was done under air pressure of from 30 to 40 pounds per square inch. In all, there were twelve such cutting shields which were handled in this manner. These cutting operations consumed a large volume of oxygen and acetylene as the sections were very heavy.

Contractor Equipment Easily Repaired

The contractor of today who handles large size jobs must have machinery such as excavators, steam shovels, drills, air compressors, trucks, and so forth. Any one of these machines may break down at a critical time when it is most needed and thus disrupt the whole organization.

With the welding torch broken gears, struts, rods, braces, and so forth, can be repaired on the job quickly and effectively. We have often been called upon for a rush job to build up broken gear teeth. Broken gear teeth can be replaced without removing the wheel from the shaft, and the repaired teeth will be as strong as the others. In building up gear teeth the metal can be worked with the torch so that machining is not necessary. Dipper teeth also can be built up by welding at comparatively small cost. A special welding rod is provided for such parts subjected to heavy wear.

Bridge Repair

The cutting torch has become one of the most useful tools to the bridge man, both in the repair of bridges and for the demolition of old bridges. If a bridge is damaged by accident, or if a member becomes deteriorated by rust, it is an easy matter with the aid of a cutting torch to replace it with a member prepared on the job. Without the torch it would be necessary to have the member gotten out in a shop where shears and drills are available.

When the train shed at Pittsburgh was partly destroyed by fire a couple of years ago, it was a serious question how to remove the warped and twisted trusses without interference of traffic. The cutting torch and a crane solved the problem. The trusses were cut into sections that could be easily handled and loaded into cars. The work was accomplished in record time without interruption of train movements.

Pipe Welding

Two of the most important items to consider in pipe line work and plumbing are flow resistance and tight joints. If the joints are not tight, there is loss, and if the inside of the pipe is rough there is loss. In the former case there is loss of water, gas, oil, steam, or whatever the pipe is conducting. In the latter, the loss is due to friction. In either case the loss is a financial loss.

In hot water heating the efficiency of the system depends entirely on the proper circulation of the water. If the pipe joints were perfectly smooth, the friction in the pipe would be reduced to a minimum and a better and more efficient system could be had. Plumbers and steam fitters realize this, and the up to date men are using the torch more and more in their trade.

In the oil and gas fields pipe welding has become a standard practice. A welded joint not only affords a joint with less friction than the standard screw joint but it makes a stronger joint. The full thickness of the wall of the pipe is used and it can be slightly reinforced whereas with the thread joint the effective thickness of the wall of the pipe is reduced as much as 45 per cent in a 2-inch pipe and 26 per cent in a 16-inch pipe.

Another thing which greatly appreciates the value of the welding and cutting torches in the construction of pipe lines is the ease with which fittings, such as tees, ells, eyes, and bends can be made in the field from the pipe on hand. No special pipe or fittings need be carried along. If it be desired to make a tee connection, all that is necessary to do is to cut off the end of the branch pipe and cut a companion hole in the main pipe. These pipes are cut with a torch along the lines of intersection. The exact cutting line can be marked on the pipe by the use of templets which have been previously developed for the size of pipe in use. When the pipes are cut they are tacked in place and then welded. If a valve or standard thread connection is desired, all that is necessary to provide for this is to weld on a nipple with standard thread.

The uses of welding and cutting torches mentioned in the foregoing by on means cover all the practices with which the civil engineer will come in contact. The field is very broad and its limits not defined. New uses devolp daily, and the indications for the future are that welding and cutting will be process indispensable to the civil engineering profession.

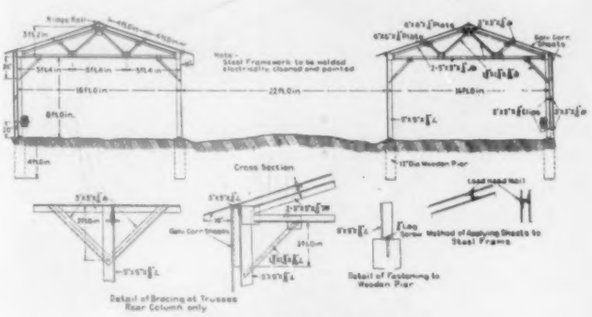
40-CAR GARAGE FABRICATED FROM SCRAP STEEL BY ARC WELDING

Utilizing structural steel that would otherwise have been scrapped, the Dallas Power & Light Company has erected, at Dallas, Texas, a 40-car welded garage for the protection of employes' cars, at a total cost of but 25% of the lowest contract price for an equivalent riveted structure. A single portable General Electric welding equipment was all that was necessary to do the work.

The garage is made of a steel angle-iron framework, covered with corrugated galvanized iron. There are two units, each 16 by 140 feet, divided into ten spans each 14 feet wide, and each unit being capable of covering 20 cars. The units face each other with a 22-foot driveway between.

The steel used in the framework of the garage was salvaged from the framework of an outdoor switching structure which became obsolete with the addition of generating equipment to the power plant. The varying lengths of the steel members removed from this structure, together with the numerous holes already punched for the switching structure (which would have interfered with the punching of new holes to fit the garage structure) would have made it necessary to splice or junk the greater part of the steel if a type of construction other than welding had been used. As the company possessed a General Electric portable arc welder, it was decided to fabricate the structure by welding.

The roof trusses are of the simple Fink type. The upper



Details of Welded Garage

and lower chords are made of two 2-in. by 2-in. angles welded together back to back. The other members of the trusses are made of 1-in by 1-in. angles. All members of the trusses are tied together with ⅜-in. plate and the trusses are tied to the columns in a similar manner. The span of each truss is 16 feet and the height of the center is 3 feet 2 inches. The purlins for the roof are 2-inch angles, with one edge welded to the truss. This leaves a flat side of the angle for the

Inside View of Completed Frame

corrugated iron roof to rest on. The columns are made of 5-inch angles. These columns are welded to the plate at each end of the truss. The back columns are braced along the run and to the truss with short knee braces. The columns are spaced on 14-foot centers. The angles to which the corrugated iron walls are fastened are welded on, the same as the purlins. All welds were of the strap and butt type. The columns are fastened to the wood foundation by means of lag screws through angle clips welded to the base of the columns, and these are the only bolts in the entire structure. The roof and walls are made of 29 gauge corrugated galvanized iron roofing fastened on with 6-inch lead head roofing nails.

WELDERS' SERVICE TRUCKS

By Jas. M. Vossler*

During 1926 a modern oxy-acetylene installation was completed at the Houston, Texas, and Algiers, La., general shops of the Southern Pacific Lines. No effort had been spared to secure the most modern and safe equipment, and only that which was approved by the National Board of Underwriters was used. The Underwriters' regulations governing such installations were followed strictly throughout the entire installations. After giving considerable study to the relative advantages and safety features of the types of installations available, an installation embodying the distribution of acetylene gas at what is termed medium pressure by the above mentioned Board of Underwriters was chosen. All pipe joints where possible, were welded, the only screw joints being

Fig. 1—Welders' Service Truck

those at valves and other fittings which were not practical to weld to the pipe.

The necessity of using pressure regulators at each set of welders equipment brought to the author's mind the possibility of damaging same when they were attached to the service station or being carried from one service station to another by the welder. The advisability of designing some means of protecting these regulators was evident. Along with this the thought of the advantages to the welder of having some means of conveniently carrying all of his equipment with him, thereby saving the time usually spent in securing his equipment from the tool room in the morning, returning same after work in the afternoon and in the many trips to a tool room or locker to secure different tips, etc., during the day. It was estimated that each welder would save three quarters to one hour per day. The development of the welders service truck shown in the accompanying illustrations naturally followed.

In Figure One will be seen one of the welders service trucks. The frame is made of scrap locomotive superheater unit tubing, and the wheels are welded from plate stock and other standard steel shapes. The tool box is made of twelve gauge sheet iron and is provided with a good lock.

In Figure Two the tool box is shown open. It will be noticed that one regulator is shown lower in the tool box than the other. This arrangement was made as it was desired to have the truck as narrow as possible so that it might easily be moved thru narrow passages and the desired width would not permit some makes of regulators being placed at the same heighth in the box. It will be noticed that racks for holding torches and tips were provided. A notch was cut at the top of the box so that a torch could be locked within the box and yet not detached from the hose. In the rear will be seen

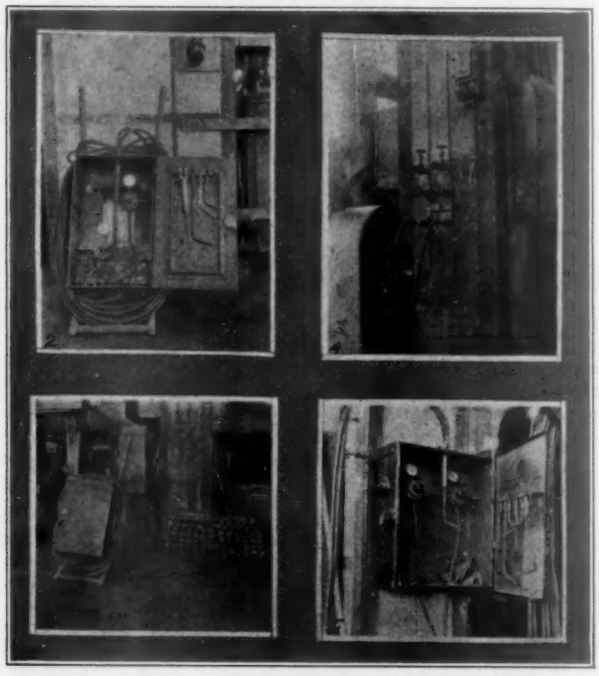


Fig. 2—Service Truck With Complete Oxy-Acetylene Equipment
Fig. 3—Connection at Service Station. Fig. 4—Double Service Station.
Fig. 5—Stationary Welder's Service Unit.

a glass enclosed instruction sheet containing rules governing the testing equipment.

As is shown in Figure Two the regulators are permanently mounted within the tool box. They are supplied with gases by a hose running from the tool box to the service station. From the outlets of the regulators a hose runs thru properly bushed holes in the bottom of the box to the torch. The length and size of the supply and torch hose is governed by conditions in the locality in which the torch is to work.

There is one very important point that must not be overlooked in construction of such a welders tool box and that is ventilation. Ample ventilating holes must be provided at both top and bottom so that if leaks should occur, the gases could easily escape. Holes were punched in bottom and top when the trucks were made, but it has since been found good to weld a piece of heavy screen in both locations.

Figure Three shows the welding equipment connected to the service station, while Figure Four shows a close up view of a double service station designed to supply two sets of welding equipment. The oxygen valve on the stations are fitted with an adapter to receive a standard oxygen regulator

*Welding Supervisor, Southern Pacific Lines, Texas and Louisiana.

inlet connection while the acetylene valve has an adapter to receive a commercial acetylene regulator inlet connection. The adapters are properly capped. The supply hose of the welding unit is fitted with a hose connection which will fit the above mentioned regulator adapters.

Figure Five shows a stationary welder's service unit whose tool box is made similar to the one described above, and is permanently attached to the wall.

The wheels shown in Figure One have been replaced with welded disc wheels, which are more durable and are proving more suitable for rough service.

CHICAGO SECTION VIEWS FILM SHOWING PIPE WELDING OPERATIONS IN THE FAR WEST

At the meeting of the American Welding Society, Chicago Section, held at the Great Northern Hotel, May 18th, one of the principal attractions was the showing of a film, supplied through the courtesy of Brown Brothers Welding Co., San Francisco, which pictured the details of construction of a huge welded water pipe line in California. The film gave definite proof of the possibility of successful welding, even under the most trying and difficult conditions. An interesting film telling the story of the development of the incandescent electric lamp was supplied through the courtesy of the General Electric Company. The subject of the discussion was the welding of piping in office and industrial buildings. This subject was discussed by welding experts, plumbers, steamfitters and engineers. The applications of welding in this field which have already been accomplished in the Chicago district have been marked with unvarying success, but there are a great many buildings in course of erection where welding has received no consideration at all, largely because the men in charge of construction have no knowledge of the process, and it is felt that proper development work will result in a great deal more welding of pipe.

STRUCTURAL WELDING BOOSTED IN CLEVELAND

"Arc Welding is an art which we cannot do without," said Joseph Matte, Jr., of Albert Kahn, Inc., Architects and Engineers, Detroit, Michigan, in the outstanding address of the May 31st meeting of the Cleveland Section of the American Welding Society. Keen interest was displayed in Mr. Matte's talk on the use of arc welding in the fabrication and erection of structural steel.

The brilliant representative from Architect Kahn's office cited many examples of where arc welding was rapidly replacing riveting in field and shop fabrication. Mr. Matte predicted a promising future for arc welding in the structural field, due to the fact that steel frame work could be erected more quickly and quietly and at lower cost by the new method.

R. E. J. Summers, Chief Contracting Engineer of the H. K. Ferguson Company, in his speech expressed the general contractor's and engineer's view of the approaching new era of steel building construction.

Cleveland Commissioner of Buildings, William D. Guion, stressed the urgent need for handbooks on arc welded construction so that building codes may be intelligently compiled to include the new method of construction. A brief talk was also delivered by Charles W. Schubert, Engineer in the City of Cleveland Building Inspection Department, in which he predicted that it would be necessary in the very near future to set up standard specifications for structural arc welding.

The rapid advancement of the design of electric arc welding equipment and the improved methods of welding were dealt with in an address by J. F. Lincoln, Vice-President of the Lincoln Electric Company. "Arc Welding in Structural work is now where riveting was twenty years ago in regard to costs, but from present indications there is every reason to believe that arc welding within the next five years will advance far beyond the present state of riveting," said Mr. Lincoln.

PRACTICAL APPLICATION OF ELECTRONIC TORNADO

A few months ago a description was published in *The Welding Engineer* of a new type of automatic carbon arc welding developed by the Lincoln Electric Company, to which the name "Electronic Tornado" was given. A report has recently been received of the practical application of this welding principle in the manufacture of oil well derrick clamps. The illustration shows in the center a finished clamp and surrounding it the three pieces from which this assembly is made. The automatic welder designed for turning these clamps out has two welding heads. The three pieces which make up the clamp are placed in an assembly machine and tack welded by hand.

Welded Derrick Clamps

They are then fed into the big welder and are carried under the arc by a chain on which dogs are set at proper intervals. It is reported that this welder is making welds at the rate of better than 40 feet an hour for each head, no filler rod being used.

NEW FRENCH TEXT ON WELDING AND CUTTING

"A Treatise on Autogenous Welding and Oxygen Cutting," by R. Granjon and P. Rosemberg, is the title of a new book just issued by the Office Central de l'Acetylene et de la Soudure Autogene, 104 Boulevard de Clichy, Paris, France. The authors of this book are well known as the authors of "Autogenous Welding," one of the first and best known books on the subject of oxy-acetylene. A great deal of what was done in their first book is so fundamental and important in detail that the essence of it has been carried over into the new volume. However, the book just published is entirely new in its arrangement of material and gives the reader a great deal of important new material, which is the result of many years of practical experiment and scientific research. It gives a far better picture of the possibilities of applying oxy-acetylene welding and cutting to industry than the authors probably dreamed of when they were preparing their first work. It also includes a great deal of valuable information along the lines of refinements of the technique of application. A particularly important section of the book is the splendid treatise in the second part, on the subject of oxygen cutting, which contains valuable suggestions on method of operating the cutting torch under different conditions commonly met in the various industries. The text is supplemented by a collection of useful tables. It contains 320 pages with about 250 illustrations. The price is 15 francs per copy.

ANOTHER WELDED PRODUCT TRADE MARKED

Another industrial product carrying a trade name, which indicates that it is of welding construction, is found in the line of tanks called "Thoro-Weld." These tanks are made by the Alliance Tank Company of Cleveland, Ohio, specialists in the construction of gasoline, oil storage tanks, oil pressure tanks, filling station tanks and other similar equipment.

G. P. A. SUMMER CONVENTION

One of the most important sessions of the summer meeting of the Gas Products Association, which will be held next month, is an open discussion on the general subject of pipe welding. The possibility of welding pipe involves a tremendous variety of constructions, but the fundamental principle is everywhere the same. That is, the elimination of possibility of leakage. It is well known that pipe assembled any other way except by welding is subject to leaks wherever joints are made. Welding when properly done actually eliminates the joints and makes leakage impossible.

The members of the association have been asked to bring with them data and photographs referring to all kinds of pipe installations for all purposes so as to get a complete collection of information regarding the possibilities of using oxygen and acetylene in this work. It is thought that by counting upon the members to contribute information from such a large variety of sources more can be accomplished than by arranging for one or two prepared papers on the subject.

The members also have up for discussion a number of important operating problems peculiar to the oxygen producing industry, and it is expected that further discussions of these problems will result in a general improvement of the standards of practice in the industry. Opportunities will be given as usual to associate members to contribute to the program.

The place of the meeting is the Homestead Hotel, Hot Springs, Va. The excellent facilities for pleasure at this hotel make it an ideal vacation spot and, consequently, it is expected that many of the members and guests will bring their families with them for an outing. There will be ample time for sports and recreation, including the usual golf tournament. The dates for the meeting are July 10, 11 and 12. Full information regarding hotel rates and transportation arrangements may be obtained by writing Mr. Stuart Plumley, Secretary, Gas Products Association, 333 North Michigan Boulevard, Chicago.

PROGRAM OF BOILER INSPECTORS WILL FEATURE WELDING

Welding as applied to boilers and other pressure vessels will play a prominent part in the Sixth Annual Meeting of the National Board of Boiler & Pressure Vessel Inspectors to be held at the Hotel Lawrence, Erie, Pa., June 18-21. Welded low-pressure heating boilers will be inspected at the plant of the Sims Company in Erie. The largest pressure vessel in the world will be seen in operation at Orville, Ohio, and a demonstration of the welding of large unfired pressure vessels under procedure control will be given at the plant of Reeves Brothers at Alliance, Ohio.

Other visits will include the plant of the Erie City Iron Works (with a demonstration of pulverized-fuel burning) and the plant of the Union Iron Works.

In addition to addresses by well-known boiler inspectors the following papers will be presented: "Dished heads," by Dr. D. S. Jacobus, chief engineer, Babcock & Wilcox Company; "Reinforcement of Openings," by H. Leroy Whitney, The M. W. Kellogg Company; "Alloy Materials for Boiler Shells and Tubes," by J. V. Romer and W. W. Eaton, Babcock & Wilcox Company; "Relationship of the Boiler Manufacturer to The National Board of Boiler and Pressure Vessel Manufacturers," by George W. Bach, vice-president and general manager, Union Iron Works.

REVISE CONDITIONS GOVERNING MILLER MEDAL

The Board of Trustees of the Samuel Wylie Miller Medal, which has been established by Past President Miller, of the American Welding Society, had no paper submitted to it during the calendar year 1927 of sufficient value to merit the award for that year. The Board has, therefore, revised the conditions under which the medal may be awarded as follows:

1. The medal may be awarded annually for any meritorious achievement, which, in the judgment of the Board of Trustees, has contributed conspicuously to the advancement of the art of gas fusion welding and cutting or the art of electric arc fusion welding and cutting.
2. The award for any calendar year shall be announced and the medal, together with a suitable certificate, presented at an Annual meeting or a Fall meeting of the Society as the Board of Trustees may elect.

The conditions governing the award of this medal have been made very broad, so that it can be granted for an achievement of any character which has contributed conspicuously to the advancement of either of the two branches of the welding art which are specifically mentioned. Thus, the award may be made for a meritorious paper or an invention or a conspicuous application of welding in industry which has advanced the art either on account of unique technical features or important economic advantages. The award may even be made for conspicuous service of a non-technical character which distinctly advances the welding art.

PHILADELPHIA EXPOSITION GETS STRONG SUPPORT

According to reports received from the headquarters of the American Society for Steel Treating, the manufacturers in the metal working industries are giving strong support to the National Metal Exposition, which will be held in the Commercial Museum, Philadelphia, during the week of October 8th.

Philadelphia and vicinity offer exceptional business opportunities for exhibitors at the National Metal Exposition because there are over 1½ times as many metal using and working plants within a radius of 150 miles of Philadelphia as in any similar area in the United States, excluding the city of New York. Eighteen million people reside within that area. Philadelphia is the center of the immense, coal, steel and general manufacturing interests of the middle Atlantic states. It is an ideal convention city, because of its great variety of manufacture; its excellent transportation facilities and splendid hotel accommodations. The National Metal Exposition is recognized as the most important annual convention in the iron and steel industry and has attracted increased attendance since the first one was held in Chicago in 1919. The total attendance in Detroit last year was 93,000, and the average for three years has been in the neighborhood of 60,000.

The fact that many national organizations are holding technical meetings during the week makes it attractive for engineers and manufacturing executives to come to Philadelphia. Many industrial executives make this exposition a regular part of their yearly plans, because of its widely known educational character. The location of such a large manufacturing center makes it a certainty that attendance will be worth while. The technical sessions of various engineering bodies provide a lot of valuable information on up-to-date methods and the Exposition furnishes an opportunity to examine at close range the equipment and supplies used in the development of processes discussed at the various meetings.

HOUSE CONNECTIONS ON GAS MAINS

One gas company has adopted the following practice for tapping high pressure mains. The method may be illustrated by the procedure for taking a 2-inch lateral off a 6-inch main. A 2-inch nipple with a flange on one end is first welded to the 6-inch main. A 2-inch valve is then bolted to the flange. With the valve open, a special drill (made up in the shop) is inserted past the valve gates. This drill carries a flange that is bolted to the outside valve flange, thus holding the drill firmly in place. The drill is operated by means of a ratchet handle. As soon as the hole is cut, the drill is unbolted, and after it is withdrawn the valve is immediately closed. In this way a main carrying any pressure can be quickly tapped without a loss of gas and without interruption of service.—*Oxy-Acetylene Tips.*

TURBINE WATERWHEEL REPAIRED BY BRONZE WELDING

An interesting example of what can be accomplished in the repair of hydro-electric machinery by means of oxy-acetylene welding with bronze, is described in the April 17 issue of *Power*.

A piece of driftwood which had come down the penstock and entered the turbine broke eleven vanes off of the runner. Rather than consider the installation of a complete new runner, arrangements were made with the wheel manufacturer to furnish individual runner blades. The broken vanes were chamfered with a portable grinder and the concave ends of the new vanes were trimmed in the shop to the proper size and shape to fit the broken blades.

The new vanes were then welded on, using a No. 8 welding tip and No. 11 manganese bronze rods. All welds were of the single-vee type, and on completion the job was smooth enough to pass inspection without further grinding or dressing of the joints. The work was accomplished so that any excess metal was on the outside of the blade and therefore would not appreciably increase the resistance offered to the flow of water through the turbine.

Based on past experience, the total cost of replacing a runner of this type is approximately $900, of which $4.00 is the cost of the new runner. A comparison of the cost of repairing this runner by welding with the installation of a new runner shows a net saving of over $600 in actual expense, as well as the fact that the welding job kept the unit out of service less than 25 per cent of the time that would otherwise have been required.

N. F. P. A. ALLOWS MORE WELDING ON TANKS

The Technical Committee of the International Acetylene Association calls attention of members to the fact that at the recent annual meeting of the National Fire Protection Association their committee on tanks used in conjunction with automatic sprinkler equipment considerably revised the rulings so as to permit oxy-acetylene welding to be employed in many places where previously welding was not permitted.

In the regulations for the construction and installation of steel gravity water tanks, Par. 705 permits the welding of ladders; Par. 706 permits outside fixed ladders to be welded to brackets which in turn may be welded to tank plates not over twelve feet apart. Par. 708 permits the welding of inside ladders to the shell by brackets; Par. 709 permits the welding of rungs to the side-bars of ladders.

With reference to steel towers, Par. 1222 states that the tops and bottoms of column shapes may be welded to the cap and base plates respectively, provided that approval of design is obtained from the inspection department having jurisdiction; Par. 1228 relating to base plates states that rigid members shall be provided between adjacent column bases when the columns are welded to the base plates and batter exceed 1.08 horizontal to 12 vertical. Par. 1404 provides that all portions of the walkway not forming major parts of the tank tower may be welded and Par 1405 provides that balcony railings and members not carrying major stresses may be welded.

The rulings in regard to wooden water tanks allow the welding of ladders and their connections.

Par. 2502 provides that couplings for pipe not larger than four inches may be welded to the tank plates in which case the couplings shall be made of extra heavy weight. A general comment on welding is found in Par. 607, which provides that all joints between tank plates and all connections shall be riveted except that welding may be used throughout the roof and for ladders, balcony railings and other minor parts. In general welding may be used only where especially permitted by the regulations of this article.

The recognition of welding evidenced by these new rulings is an encouraging advance in this field. It is hoped that this opening will be enlarged by favorable experience with the new rules.

ALL WELDED GAS HOLDER

By F. H. Beebe*

There has just been completed at Albion, Michigan, the largest all electric arc welded low pressure gas holder ever built. The construction and design are both the work of the Western Gas Construction Company, of Fort Wayne, Indiana. The holder with all lifts elevated to their maximum height stands 113 feet 7 inches above the foundation. It has a diameter of 74 feet and weighs 516,385 pounds plus the weight of the welding rod that was used. The gas holder has a capacity of 300,000 cubic feet of gas at a water pressure, when full, of 12 inches.

A 15,000 cubic foot single lift gas holder of all arc welded steel construction was built by the Western Gas Construction Company for the Missouri Gas & Electric Company at Lexington, Missouri, in 1924, and with this one exception, the Albion holder is the only and largest low pressure gas holder built entirely by arc welding. The previous welding work done on gas holders seemed to lead logically to its exclusive use, for welded joints have proved perfectly satisfactory in structural strength and are gas and water tight. One of the great advantages of using electric welding on gas holders lies, of course, in the latter fact.

Fig. 1—Arc Welded 300,000-cu. ft. Gas Holder

Building a gas holder by electric arc welding has inherent practical advantages that recommends it strongly. It simplifies construction and reduces fabricating cost. When a gas holder is made of riveted plates it is necessary to employ the tank shop to lay-out and punch all the members. When metallic arc welding is used it is only necessary to layout and punch the members in the shop for fitting up bolts. The plates are, of course, rolled to the proper radii in the shops. On this job the plates were assembled in position with bolts and tack welded with the exception of the cups and grips,

**Vice-President, Western Gas Construction Company, Fort Wayne, Indiana.*

which were fabricated in the shops, assembled in sections on the ground, and welded in place.

Figure No. 4 shows the gas holder with the water tank under construction. The bottom was assembled and welded on the foundation which was three feet below yard level and incidentally in this case, below the water line. Excavation was made around the foundation forming a pit, in the center of which was the foundation. The bottom and first course was built on the foundation and water was allowed to stand in the pit at a height of about 12 inches above the foundation. In this manner the bottom and lower curb was tested for leaks and it is interesting to know that none were found.

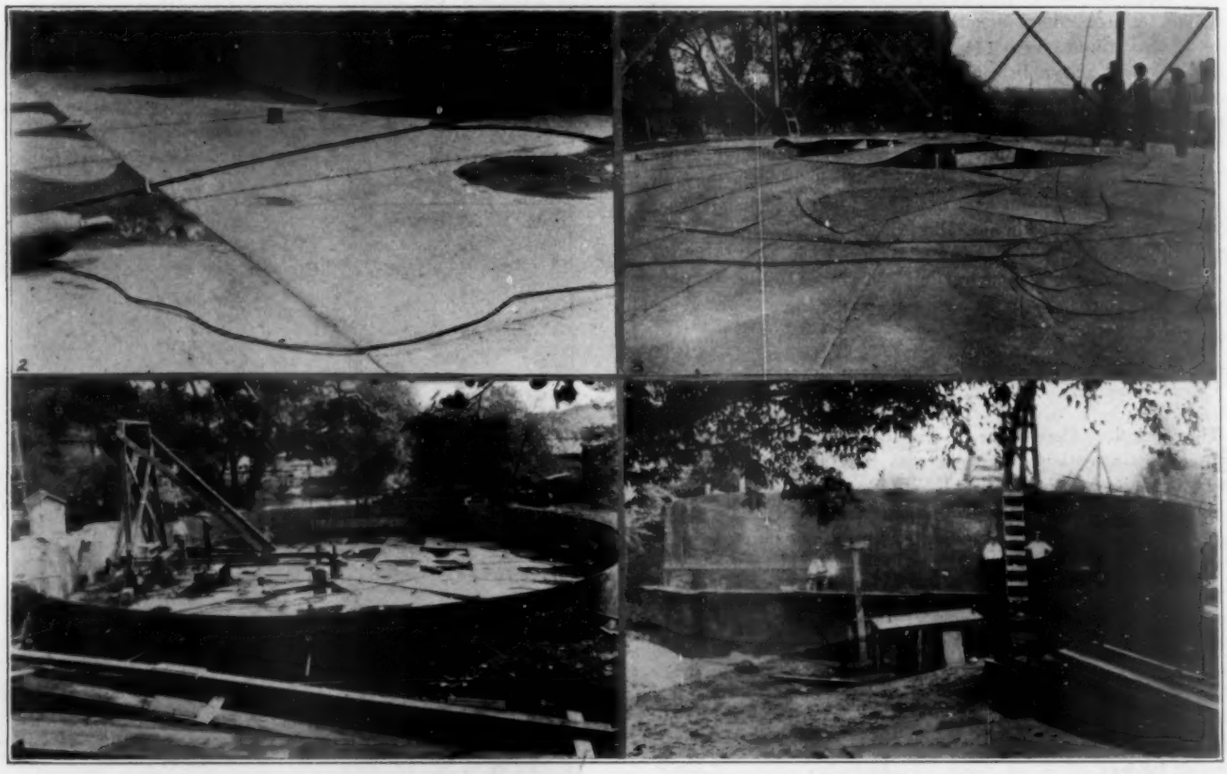
The structure shows in Figure No. 2, against the circular plates in the upper right hand corner, is what is known in gas holder construction as a cup. The ease with which these cups were built by electric welding is quite clearly shown. I-beams were welded together and to the floor forming the landing blocks.

Figure No. 3 shows the gas holder at the time of the completion of the water tank. When this photograph was taken the final welding was in process. The joints were of the lap type, a variety easy to weld. In this picture a fairly comprehensible suggestion of the bracing may be glimpsed above the upper course. It was not elaborate and consisted of virtually the same elements that would be necessary on a riveted job. All through this work it was the simplicity of welding that was its greatest virtue.

The guide frame was entirely arc welded, the only bolts that were used being those employed in assembly. Around the top of the different lifts can be seen the goose necks. In the past these have been of riveted construction. On this job they were fabricated with metallic welding.

The finished gas holder is shown on Figure No. 1 rising to its full 113 feet 7 inches. For the information of those who may wonder about the plates that form the sides, it might be well to state that the water tank ranges from $\frac{7}{16}$-inch to ¼-inch stock and the three lifts of No. 10 gauge. Everything on this gas holder, as has been stated before, is completely welded. There are no other types of joints, the ladders, and the platforms being assembled by welding.

Figure No. 3 shows the crown of the upper section being laid. In laying this crown, a wooden under structure was built on which the plates could be laid. When this was ready, the plates were swung into position and tack welded. They were laid in circular rows from the outside to the center, each succeeding course being lapped over the one before. As the plates were placed they were tack welded to hold them in position and when all was ready the finishing welds were made.



Views Taken During Building of Holder Showing Details of Welded Construction

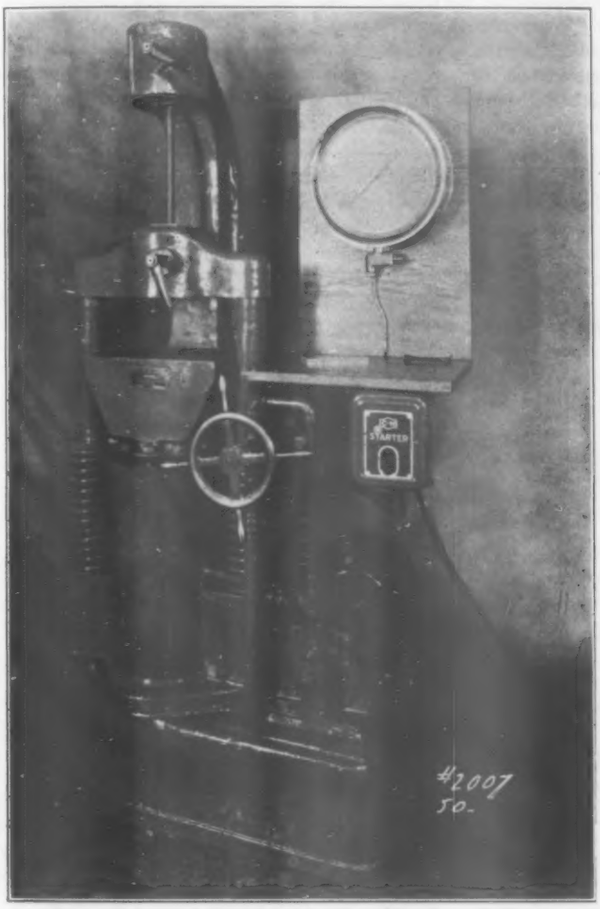
On this gas holder four tons of electrode welding rod were used. If a holder of the same size were made of riveted construction 7½ tons of rivets would be necessary. Four "Stable-Arc" welders manufactured by The Lincoln Electric Company, Cleveland, Ohio, placed 21,414 lineal feet of welding. The entire job was carried through almost without a hitch and with much less difficulty than would naturally be expected with a new structural process. It seems beyond a doubt that in the future gas holders will be fabricated by electric welding as a matter of course. There is so much to recommend it that it will inevitably find universal adoption. The great benefits, as has been said before, lie in the facts as that; first, by using welding the greater part of the shop fabrication is eliminated; second, that after the structure is once tested and freed from leaks there is little or no chance for trouble to develop.

The holder at Albion, Michigan, was built largely through the cooperation of Mr. D. F. Burritt, vice-president, in charge of Engineering of the Middle West Utilities Company, Chicago, Illinois, and Mr. Roy Campbell, president of the Albion Gas Light Company, who are ever alert to the possibilities of newer and better construction of equipment.

NEW MACHINE FOR TESTING WELDS

Southwark Foundry and Machine Company, Philadelphia, Pa., working in association with A. H. Emery, has placed on the market a 60,000 lbs. capacity Universial testing machine which weighs only 2,000 lbs. and occupies but five square feet of floor space. This machine is a self-contained unit, semi-portable, requiring no foundation, ready to go into action wherever it may be set up and plugged into a lighting circuit.

The machine, despite its small size, is fitted with the well known Emery weighing system, by which the tension or compression loads are shown with high degree of accuracy on a



New Type of Tensile Tester

16-inch open-face dial mounted on an instrument board in front of a convenient writing table, built into the machine. The accuracy and sensitivity characteristic of the Emery weighing system is not in any way sacrificed to obtain compactness or simplicity. The hydraulic support itself is located in the base beneath the cylinder.

This machine, which operates silently and rapidly, is designed with a new convenient form of wedge grip that is one of the aids to a quick, easy test. Rapid speed change and reversal of direction by the single handwheel, visual load reading, absorption of the recoil shock in the hydraulic system, all tend to increase the speed and convenience of testing. Loads may be held stationary at any point, or increased or decreased at will. Any testing speed from standstill to 6 inches per minute may be obtained. The tiny pump has five cylinders arranged radially around its shaft. It is direct connected to its one-horse-power driving motor. This power plant delivers non-pulsating flow.

C. L. GULICK AND G. O. CARLSON LEAVE WHARTON ORGANIZATION

Charles L. Gulick and G. O. Carlson, who have been identified with the cylinder department of the William Wharton, Jr., Company, Easton, Pa., since March, 1919, have resigned their positions to enable them to undertake other activities. It is understood that Mr. Gulick has made plans to supply compressed gas cylinders covering all sizes, from the very smallest to the very largest. Mr. Carlson is now connected with the Latrobe Electric Steel Company, with headquarters at New York City, and Mr. Gulick has made arrangements to have the use of Mr. Carlson's services as occasions should require.

Mr. Gulick has for the past eighteen months been working with Dr. H. E. Sturcke for the development of Dr. Sturcke's new overflow cylinder testing jacket. A catalog is now in course of preparation covering this jacket, and those who have testing problems will soon be able to make arrangements to have the benefit of the inventor's years of experience.

MILBURN COMPANY APPOINTS NEW ADVERTISING MANAGER

Mr. E. D. Hallock has become identified with The Alexander Milburn Company of Baltimore, Maryland as advertising manager.

Mr. Hallock has had extensive experience in general advertising and in publicity work. For a number of years he was advertising manager for the Gray & Dudley Hardware Company of Nashville, and later prepared the advertising of a number of companies, including the advertising campaign for the Solvay Process Company which attracted widespread attention. He was associated for a number of years with one of the largest New York advertising agencies and later with the Green & Van Sant Company of Baltimore.

NEW FLUX FOR BRONZE WELDING

A circular received from the Simplex Flux & Solder Company, 1965 East 66th Street, Cleveland, Ohio, describes the use of Lotan flux for bronze welding. This is a new flux which has just been introduced to the American market and is really a combination flux. First, there is the Lotan powder preparation, which is used to decarbonize the surface of the iron and to clean it thoroughly so that a good strong bond can be obtained. This is sprinkled on the surface of the joint while it is being heated so that the torch flame will blow the powder into the surface of the iron. It is then ready for the application of the bronze, and for this operation the Lotan A-B flux is used in the conventional way. This combination of fluxes has already been tried on a number of important types of bronze welding jobs and manufacturers report that it has also been highly satisfactory wherever their instructions have been carefully followed.

A. W. P. ADVERTISING EXTENSIVELY

One of the leading promoters of welding in the British Isles is the firm of Alloy Welding Processes, Ltd., of London. A series of reprints of some of their magazine advertising, recently received, shows that they divide emphasis between the good qualities of their own products and the advantages of using welding for both fabrication and repair. Their advertising will be found in the leading English publications devoted to welding, and also in engineering and technical journals. They have also published a number of interesting pamphlets on various phases of welding. A recent one gives full details of a report by the National Physical Laboratory at Teddington, on the welding glasses supplied by the company. Another illustrates and describes welding machines built especially for government departments, railways, etc.

NEW TYPE OF PORTABLE WELDER

A portable electric arc welding unit, embodying several new features, has been developed by the Shrader Electric Company of Los Angeles, California. The electric generating equipment is mounted in the driver's compartment of an automobile truck or roadster and the generator is driven by the automobile motor with a patented magneto governor of an entirely new design for controlling the throttle of the motor. When the generator is pulling a full load, up to 300 amperes continuous flow, the automobile speedometer, hooked up to the drive shaft, registers approximately 20 miles an hour showing the motor need run only at a normal speed.

In this unit the power take-off is hooked into the automobile drive shaft and may be thrown in or out with its own gear

Shrader Portable Welder

drive arrangement and shift lever. With the generating unit thrown out, the automobile functions as originally designed to function and the generator unit is no hindrance to traveling over the highways at any desired speed. Naturally this generating unit may be built into any type of automobile which has sufficient power to drive the generator, but the Shrader Electric Company have standardized on a style of equipment for the market which has proven to best meet the requirements.

This standard unit, as illustrated, is built into a Chandler Truck. The generating unit sits between two separate seats in the driver's compartment and gives full access to the original carrying capacity of the truck body. An acetylene tank is carried on one side of the body and an oxygen tank on the other as a preparation for acetylene welding when necessary. The electric leads from the generating unit are carried on two reels mounted on the right hand side of the car body. This unit, fully equipped with the two tanks and full electric equipment, weighs 4510 pounds, but 1000 pounds more than the weight of the truck itself. By utilizing the magnetic governor arrangement for controlling the power no switchboard is necessary and the welder has at his command from 25 to 400 amperes with the opportunity of setting any desired heat which, once set, will remain constant.

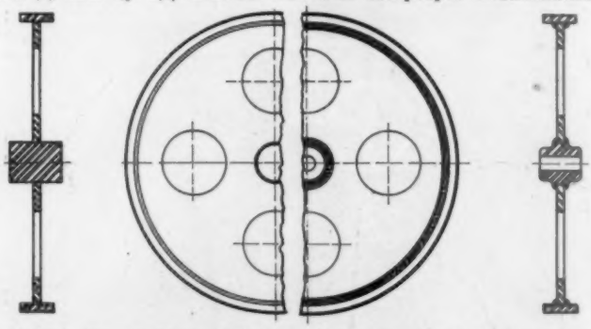
ISCO CAUSTIC POTASH IN WALNUT SIZE FOR LIQUEFACTION PLANTS

Introduced as a means of cutting down operating costs of liquefaction plants, Isco American Selected Walnut Size Caustic Potash, manufactured by Innis, Speiden & Company, 46 Cliff Street, New York City, has during the little more than two years it has been available, amply fulfilled its purpose. Undoubtedly, every manufacturer who uses air and gas drying equipment is familiar with the high cost of "freeze-ups" resulting from the use of caustic potash or other chemicals which are not especially made for the purpose. Conservative estimates place the cost of a plant "freeze-up" at from $150 to $350. Experience proved that the material formerly used did not have the proper amount of efficiency as far as drying the gases was concerned, thus making it necessary to prolong the operation of passing the gases through the drying cylinders and consequently raising manufacturing costs. Isco American Selected Walnut Size Caustic Potash was perfected as an antidote for these troubles.

This new grade of potash is thoroughly an American product, being first manufactured in New York State in solid form and then processed into the walnut size pieces, and packed in small, easily handled, friction-cap drums of 100 pounds each. Every step in the operation is carefully controlled so as to eliminate the troubles encountered with the ordinary grade of caustic potash formerly used. Inasmuch as the two chief functions of this product are to absorb moisture and carbon dioxide from the gas being manufactured, it is very essential that it be at once low in carbonate content, and as dry as it is possible to make it. These two features are carefully controlled at the chemical manufacturing plant and the operation of processing it into walnut size pieces is done so quickly and efficiently that practically no moisture is absorbed, or carbonates formed. The pieces are of uniform size and are packed into the small 100 pound drums, entirely free from the fine particles which are the chief cause of the "freeze-ups."

SIMPLE DESIGN FOR WELDED TRUCK WHEEL

A design of wheel adapted for use on a variety of trucks is shown in the illustration below. The assembly of the plate, rod and bar are shown at the left, while the completed welded wheel is represented at the right. The wheel illustrated is constructed of a ⅜ inch by 1¾ inch bar rolled to the proper circumference,



a ¼ inch circular plate drilled as shown, and the hub of two-inch bar stock, drilled after assembling for the axle. This wheel, which is easily and quickly fabricated, has proved much stronger and more durable than the usual spoke wheel.

NEW HOLLUP CIRCULAR

The C. H. Hollup Corporation of Chicago has just published an interesting four-page circular which gives Hollup customers some intimate details of the operation of the Hollup plant in Chicago; an especially interesting feature is the photograph of a machine for automatically applying the coating to welding electrodes. It is pointed out that this machine can automatically control the thickness of the coating on the welding wire down to 1/1000th of an inch.

NEW AIRCO BOOKLET

Oxy-acetylene Welding in the Foundry is the title of a booklet recently prepared by the Air Reduction Sales Company, New York City. The text was prepared by Mr. G. F. Wieser of the Engineering Research Department of the Air Reduction Company, for the welding conference held at the University of Wisconsin, last February. The booklet gives a complete survey of the possibilities of oxy-acetylene welding in a modern steel foundry and gives a wealth of valuable suggestions on welding procedure.

NEW BOOKLET ON CARBIC LIGHT

The Oxweld Acetylene Company, New York City, have recently issued a new booklet concerning the portable Carbic light. The first half of this booklet illustrates and describes a number of different types of work on which it is advantageous

to use acetylene flood light. This is followed by a discussion of the features of the Carbic light, and the last part of the book contains illustrations and descriptions of four different types of lights.

MILBURN COMPANY IMPROVES PAINT SPRAY

The Alexander Milburn Company, Baltimore, Maryland, recently announced improvements on their paint spray gun. A dialed head has been added, which gives numerous different spray adjustments, from a circular spray to a fan of wider field than has heretofore been possible. The dialing permits the operator to obtain any desired spray, incidentally, without first making tests. A series of indicator numerals on the paint valve plunger has also been added. A pointer is operated as the operator turns the adjustment button. Just as the dial in the head produces the exact spray wanted, so the indicator numerals on the paint valve plunger provide the exact volume desired without the necessity of losing time by testing. The operator, having found that a certain class of work is best performed when the indicator points to a certain figure, makes the proper adjustment before beginning to spray. The new spray gun is known as the Type EF. The additions mentioned have been made interchangeable, so that the Type E gun can be brought up-to-date by the insertion of these parts by the factory.

FOLDERS DESCRIBING WELDING EQUIPMENT ISSUED BY GENERAL ELECTRIC

A series of folders illustrating and describing a number of General Electric products include four of special interest to the welding trade.

Bulletin GEA-823A explains the atomic hydrogen process and describes the equipment used, including the reactor, transformer, and special electrode holder. A wiring diagram for the complete system is also given.

Bulletin GEA-874 illustrates the new Type WD-200A Arc Welder, which can be operated with belt, motor, or gas-engine drive, as a staionary or portable welder. This machine is described as a self-excited, constant-energy, single-operator welding generator. N. E. M. A. rating, 200 amperes, one hour. Current range, 50 ta 300 amperes.

This same machine, mounted for portable use and driven by a Continental P-20 Motor, is illustrated in Bulletin GEA-881.

GEA-569A covers the general line of arc welding sets, with shipping weights and dimensions of the motor-generator sets and of the generator panels. The control apparatus is also illustrated.

BUCKSKIN GLOVE DESIGNED FOR WELDERS

The importance of comfort and convenience as well as protection in a welder's glove has led Morrison-Ricker Mfg. Co., Grinnell, Iowa, to design a glove of buckskin, with a woven fabric palm and thumb lining, and a six-inch cuff to protect the arms. The makers state that this glove is already being used in quantity by many firms with extensive welding operations.

NEW HARD SOLDER FOR REPAIRING CASTINGS

A product sold as "Johnson's Magic Solder" is being introduced to welding shops, garages, and plants where repairing of cylinders, crankcases, cylinder heads, and similar castings is necessary. The manufacturers, J. Linn Johnson Manufacturing Co., Wilkes-Barre, Pa., claim that with this solder no acids, salts, or soldering iron are necessary.

OBITUARY

William Thompson Bonner

With deep sorrow we announce the death of William T. Bonner, a well known contributor to the pioneer work in the welding industry, who passed away suddenly May 6, 1928, in Brooklyn, N. Y. Mr. Bonner was born in Chillicothe, Ohio, October 14, 1859. He studied and practiced engineering as a young man in the Middle West and after completion of several western contracts opened engineering offices in New York City, March, 1893. Since that time he has been continually in responsible charge of engineering design and construction work, both land and marine. In 1890 he designed and directed the erection of a 1,000 horsepower plant for an important lead works, including a 150 ft. brick chimney on 30 x 30 ft. oak timber and concrete foundation floated on Missouri River quicksand. Recent reports indicate this entire plant in perfect condition and service. In 1891 he planned and directed the erection of the 1,000 horsepower plant for Chicago's first steel skeleton skyscraper office building. In 1892 he designed and superintended the erection of the first known proportioning and concrete mixing machine. This was used in the preparation of all concrete required for the first hydraulic power tunnel at Niagara Falls, 18 in. bore and 6,850 ft. long.

During the period, 1895 to 1902, Mr. Bonner planned and erected model steam generating plants in Vancouver, Winnipeg, Toronto, Montreal, Quebec, Halifax, St. Johns, Sidney and other Canadian centers, aggregating many thousand horsepower and most of them under very difficult engineering conditions.

In 1916-17 he designed and constructed the first seagoing bulk oil barge, 1,200 tons, *with principal strength members wholly welded* and without a single perforation for erection. Upon completion, the barge was towed 2,300 miles to Tampico, Mexico, with a full cargo of machinery, and arrived in perfect condition and has since continued in constant oil transport service.

Mr. Bonner was a frequent contributor to technical journals and society discussions. His crowning literary work, which will be found in the principal world libraries, is his editing of the New York World Metropolis, a Commemorative Edition—a history of 1,000 pages of New York City, it being recognized today as an encyclopedia of the city's development from the date of its settlement to the date of its publication, 1924.

The Marine Journal latterly carries his last contributions to the literature of the welding industry. Certainly they will always prove of great worth to welding engineering and lore. A posthumous article, in fact, two, will appear in due course in the same paper. He there prophesies his discovery of a perfect method of testing welds without destroying the weld.

THEODORE KAUTNY

Word has been received that Mr. Theodore Kautny, a well known pioneer in the oxy-acetylene welding industry, passed away at his home in Germany on May 21, 1928. His book, "Autogenous Welding and Cutting" and "Handbuch der Autogenen Metallbearbeitung," are his best known texts and the monthly magazine, "Autogene Metallbearbeitung," has for many years continued to have a considerable circulation in this country. Mr. Kautny leaves a wife and two daughters.

WESTERN NEW YORK SECTION HAS ROUSING MEETING

The regular monthly meeting of the Western New York Section of the American Welding Society was held in the Fillmore Room of the Hotel Statler at 8:00 p. m., May 25, 1928.

This also being the annual meeting the following officers were elected, and committee chairmen appointed:

Chairman: Mr. F. L. Rodgers, District Sales Manager, care of Linde Air Products Company, 956 Main Street, Buffalo, N. Y.

Vice-Chairman: Mr. Edward S. Hebeler, Vice-President, Allan Mfg. & Welding Co., 726 Washington Street, Buffalo, N. Y.

Secretary and Treasurer: Mr. G. W. Swan, care of John A. Roebling's Sons Co. of New York, 500 Morgan Building, Buffalo, N. Y.

Chairman of Papers and Meetings Committee: Mr. Robert Siemer, President of Allan Mfg. & Welding Co., 726 Washington Street, Buffalo, N. Y.

Chairman of Membership Committee: Mr. Ralph W. Bannar, Manager, Welding Sales, Root Neal & Company, 178 Main Street, Buffalo, N. Y.

Chairman of By-Laws Committee: Mr. C. H. Lockwood, care of General Electric Co., Electric Building, Buffalo, N. Y.

Representative to the American Welding Society: Mr. Robert Siemer, President, Allan Mfg. & Welding Co., 726 Washington Street, Buffalo, N. Y.

The speaker was Prof. Frank P. McKibben, graduate and professor from Massachusetts Institute of Technology, Professor of Lehigh University and Professor at Union College Schenectady, at present being Consulting Engineer for the General Electric Company, specializing on welded steel structures, also consulting engineer for the city of Schenectady.

Prof. McKibben's experience as a designing engineer and engineer of construction covers such a very long list of the largest enterprises in existence that space does not permit mentioning them in detail.

Prof. McKibben explained to his audience the erection of steel bridges from the very beginning of the use of steel for such work, further explaining the progress of methods used in the fabrication of these structures, bringing us up to the present time when welding has been found the most advantageous, both as regards the physical qualities and the financial cost.

He illustrated by lantern slides some of the recent steel buildings erected by welding, showing and explaining in detail the large buildings of the General Electric Company at West Philadelphia, in which some 1,000 tons of steel was used, all being electric welded.

WARNS AGAINST UNDUE REDUCTION IN WEIGHT WHEN WELDING STRUCTURAL STEEL

A communication received from Messrs. Alloy Welding Processes, Ltd., London, sounds a note of warning in connection with the designing of welded steel structures. They point out that it has not yet been possible to determine the saving of material which will result when electric-arc welding is used in place of the present riveting and bolting methods.

It is evident that when a 5/8" diameter hole is to be drilled through a 2" member, that the strength of the member is reduced by more than 25%, and it has been argued from this that the strength of the sections used in constructional work when welded may be safely reduced by 25%. It is felt, however, that if designs are prepared on this basis that weaknesses may occur.

Some amazingly light steel structural work is being designed in a rural part of England where surveyors are possibly a little bit easier to deal with than they are in more densely populated parts. In this case the saving of weight approximates 35% of the standard riveted practice, and while the designing may be right, it is felt that progress in the direction of cutting down dimensions of the steel work should be very cautiously proceeded with until experience has shown how far welding will assist in this particular direction.

The engineer who has to design riveted structures is very much hampered by reason of the cost involved in making unusual joints. Welding is, of course, an enormous advantage in this direction, as the joining up of some supplementary truss member of a very desirable nature, can be accomplished in the matter of minutes, whereas, with riveting it may be necessary to cut out a special plate and to bend it into all sorts of shapes before it can be used for the purpose of forming a riveted joint.

In all probability the ultimate welded steel structure will differ from the present form of riveted structure as much as the modern motor car differs from its early form. It is only to be expected that the coming engineer trained in the art of welding will approach the problem of designing steel structures from a fresh standpoint, and in this way saving of weight will be effected while strength is increased.

It is felt that much of the progress will be made in connection with the use of tubular members. Such members could not possibly be made use of in connection with riveted structures, owing to the difficulty of making a satisfactory joint. This difficulty disappears when welding methods are available.

HEAVY WELDING IN AUSTRALIA

That Australian industries are keenly interested in the possibilities of welding is plainly evident by a number of stories appearing in a recent issue of *The Australian Welding Engineer*. In these stories some very interesting jobs of heavy welding are described. One of them is a 17-mile pipe line, 42 inches in diameter, the pipe itself having longitudinal seams arc welded. Another article describes the application of welding in the construction of new bridges and in the repair of the other bridges in Victoria. A third article deals with welding as applied to the construction of gas plants and the author states that his company has already built five welded gas holders.

INTERESTING LETTERS ON MANY SUBJECTS

The first of an interesting series of letters on business engineering, etc., has been received from Mr. Robert E. Kinkead, consulting engineer, 3030 Euclid Avenue. Cleveland, Ohio. These letters mix common sense with a very wholesome philosophy and some original ideas which are handed to the reader without excuses or apologies. Mr. Kinkead sends these letters only to personal acquaintances or to people who specifically ask for them. The letters cover quite a variety of subjects and prominent among them is the possibility of making savings by using welding in places where it has not been used before.

KORO CORPORATION UNDER NEW MANAGEMENT

The Koro Corporation, Waukegan, Illinois, manufacturers of Koro electric arc welding wire and Koro Tobin bronze welding rod, has recently been reorganized and the following officers elected:

President: E. L. Ives.

Vice-President: C. D. Tripp.

Secretary-Treasurer: A. B. Markus.

Several important improvements have been made in the products of the corporation, concerning which detailed announcement will be made in the near future. Arrangements have been made to increase the manufacturing facilities and also the distribution facilities for the Koro line.

Mr. O. L. Howland, who has for several months been sales manager, with headquarters at Waukegan, Illinois, has been appointed general manager of the company.

News of the Welding Trade

Charles W. Steele, a sales engineer, for many years identified with the oxy-acetylene industry, has become associated with the Burdett Oxygen & Hydrogen Company, of Chicago, with headquarters at 19 No. Sheldon Street, Chicago, Illinois.

The Burdett Oxygen Company (Oklahoma) a unit of Compressed Industrial Gases, Inc., has purchased property at Oklahoma City and will erect a new plant for the manufacture and sale of compressed acetylene. The erection of the necessary buildings with machinery will involve an investment of approximately $100,000.00 and it is anticipated that the plant will be in operation during the month of September.

It is reported that the A. O. Smith Corporation has received an order from the Texas Company for 24 thousand tons of electrically welded 8 inch steel pipe to be used for

Tobin Bronze repair-welding restored this air compressor cylinder to service at a fraction of the cost of a new cylinder.

ANACONDA
from mine to consumer

There is a suitable Anaconda Filler Rod for every welding purpose. The principal Anaconda Welding Rods, with their melting points, are listed below:

for oxy-acetylene welding

Tobin Bronze	1625°F
Manganese Bronze	1598°F
Brazing Metal	1634°F
Deoxidized Copper	1981°F
Electrolytic Copper	1981°F
A. B. Naval	1625°F
Everdur	1866°F
Ambrac	2102°F

for arc welding

Phosphor Bronze	1922°F
Everdur	1866°F
Ambrac	2102°F
Deoxidized Copper	1981°F

This 700-lb. cylinder repaired with TOBIN BRONZE

Reg. U. S. Pat. Off.

in five hours

The cylinder shown in the illustration is part of an Air Compressor. It weighs 700 pounds and the walls are 1¾ inches thick. It was badly fractured by freezing, and the owner was faced with the possibility of a high replacement expense.

A new cylinder would have cost $700, but welding with Tobin Bronze was suggested, and the broken cylinder was quickly restored to service. 18-inch welds on each side of the casting have made it as strong and sound as it was before the fracture.

This weld required:—

3½ hours actual welding time, plus 1½ hours for chipping

20 lbs. Tobin Bronze

3 bushels charcoal used in preheating

Tobin Bronze—an exclusive Anaconda Product—is the most satisfactory material for general oxy-acetylene welding of cast iron. The low welding temperature required (Tobin Bronze flows freely at 1650° F.) eliminates the extensive preheating required when welding with iron or steel rods and often makes dismantling unnecessary.

Tobin Bronze Welding Rods are made by The American Brass Company and sold by leading distributors of welding supplies. Every rod bears the name "Tobin Bronze" stamped in the metal.

THE AMERICAN BRASS COMPANY
GENERAL OFFICES: WATERBURY, CONNECTICUT
Offices and Agencies in Principal Cities
Canadian Mill: ANACONDA AMERICAN BRASS, LIMITED
New Toronto, Ontario

ANACONDA
WELDING RODS

"STANDARD"
Welding Wire
GAS AND ELECTRIC

for sound permanent welds : : lower costs

Our costs are considerably under those of large industrial centers; ours is a one-profit wire sold direct to user from our own mills exclusively devoted to making of welding wire from raw material to finished product—hence our extremely low prices for wire that is definitely superior. Adopted exclusively by many large users.

Prices on request.

A grade for each type of work—send for samples. Standard Steel & Wire Co., Greensburg, Pa. (Mills at Bolivar, Pa.)

an oil line. It is said that this order will total approximately one thousand carloads.

The Elkon Works, Weehawken, New Jersey, have opened a New York office at Room 415, 350 Madison Avenue, New York City. The Elkon Works specializes in the manufacture of Elkonite, an alloy used for making tips for electrodes used in electric resistance welding.

The Welding Service Company, 50 Church Street, New York City, have recently brought out a new leaflet describing the various types of arc welding equipment, accessories and welding wire manufactured by the General Electric Company.

Mr. W. G. Robbins of the sales department of the Stoody Company, Whittier, California, has recently started on an extensive trip across the country, which will include visits to Detroit, Chicago, St. Louis, Cleveland and New York.

The Chicago Sales office of the Joseph Dixon Crucible Co., Jersey City, New Jersey, manufacturers of graphite products, is now located at 2003 Builders Building, on the corner of Wacker Drive and La Salle Street.

L. W. O'Day, formerly connected with the Chicago office of the Lincoln Electric Company, recently joined the sales forces of the Koro Corporation, Waukegan, Illinois, and has been assigned to the Chicago district.

The Chicago office of the Manganese Steel Forge Company, Philadelphia, Pa., manufacturers of manganese welding rods, has recently moved from the Old Colony Building to the Builders Building. The Chicago branch is under the management of Mr. W. H. Potter.

E. D. Terry of 156 Fifth Ave., New York City, has been appointed by the Standard Steel & Wire Co. of Greensburg, Pa., manufacturers of welding wire, as their representative in New York City and vicinity.

Mr. J. T. Edmunds, manager of Edmunds Brothers Company, importers and distributors, Melbourne, Australia, is making an extensive trip through the industrial centers of the United States, giving particular attention to new developments in applications of the different welding processes.

At the Third Annual General Meeting of the Victorian Institute of Welding Engineers, Mr. W. H. Crabtree, Manager of The Australian Oxygen & Industrial Gases, Ltd., Melbourne, was unanimously elected as president for the ensuing twelve months. Mr. H. Rigby, of Messrs. Robt. Bryce & Co., Ltd., was elected as vice-president.

Classified Ads

Help Wanted—75c per line, minimum 4 lines.
Jobs Wanted—4 lines free.
Other Ads—$1.00 per line, minimum 4 lines.
Counted 8 words to line. Add 6 words for keyed address.

For Sale—No. A-1 Davis Bournonville Oxygraph Cutting Machine for cutting various shapes. Condition good. Price reasonable. John J. Adams, Corner Winona & Nebraska Streets, Worcester, Mass.

Electric Welders—All types, new, used. W. Montelius Price Co., Seattle, Wash.

Attention, Welders!

Have you tried Gold Seal Fluxes for Bronze Welding, Cast Iron, Steel and Malleable?

Successfully brazes on dressed or undressed fractures: No. 1 for Cast or Malleable, No. 2 for Steel. Price $1.00 per pound, each, Postpaid.

GOLD SEAL MFG. CO.
Cor. of Pascal & Como St. Paul, Minn.

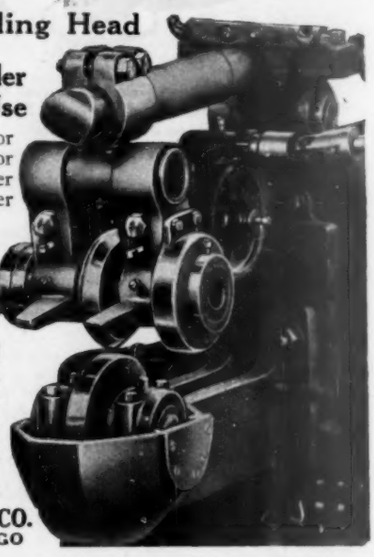
Lewis Seam-Welding Head
PATENTS PENDING
Fits Any Spot-Welder
Proven by 3 Yrs. Use

Will weld *side seams* or *bottoms* of buckets, pails or tanks at 15 to 25 ft. per minute and make joint water and gas tight.

Change from "Spot-Welder" to "Seam-Welder", or the reverse, made in 5 minutes.

One user has made over 1½ million 3 inch lap joints and then nickel plated the piece. **You can't find the joint.** No change to your spot welder — simply clamp Head to upper horn. Bolt on the proper electrode for either transverse or longitudinal welding. The "drive" is a separate unit and NOT attached to spot welder.

Send at once for Bulletin 129.



WELDING APPLIANCE CO.
2111 West Lake St., CHICAGO

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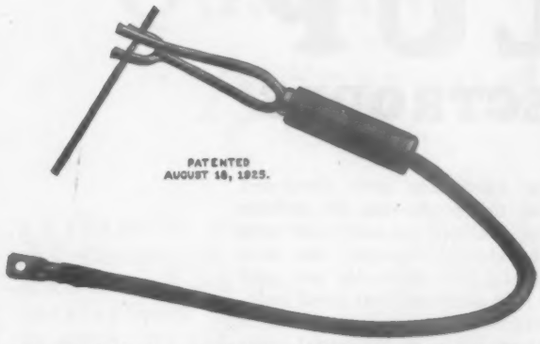

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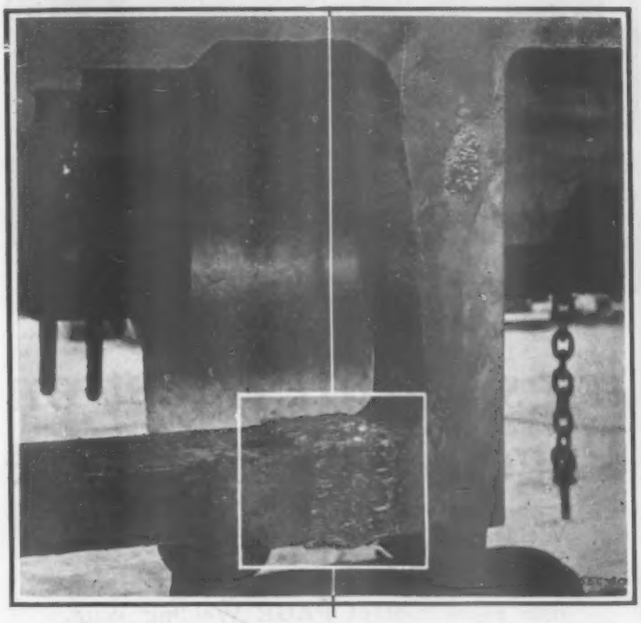

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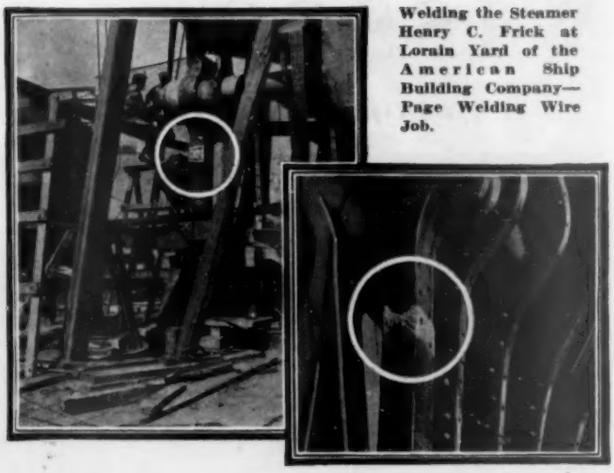

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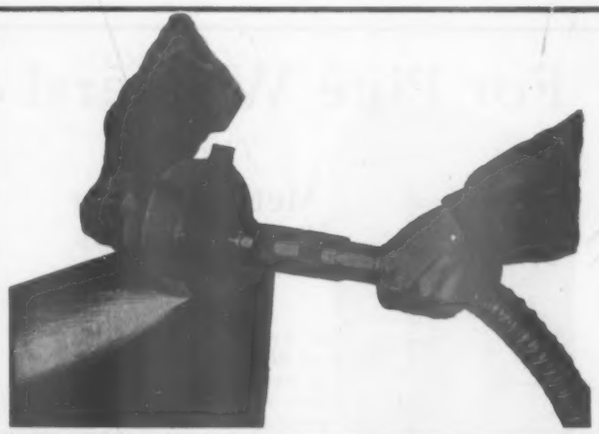

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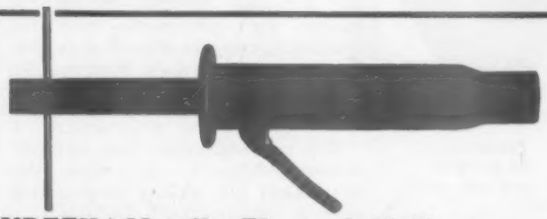

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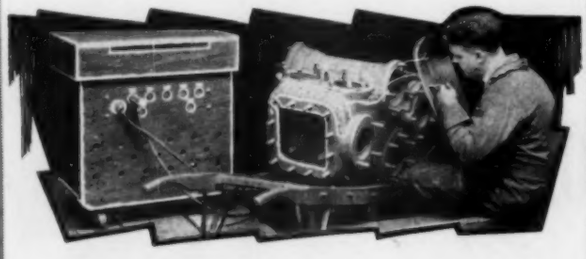

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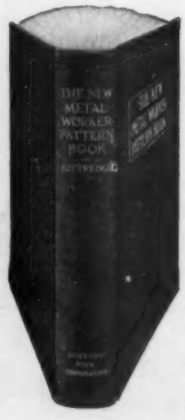

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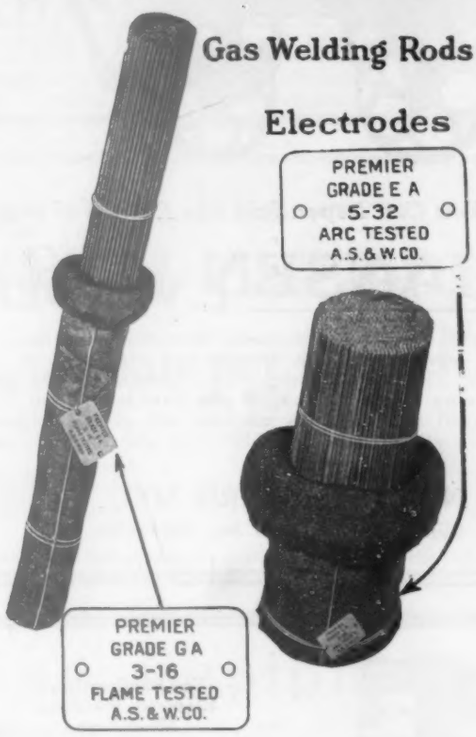

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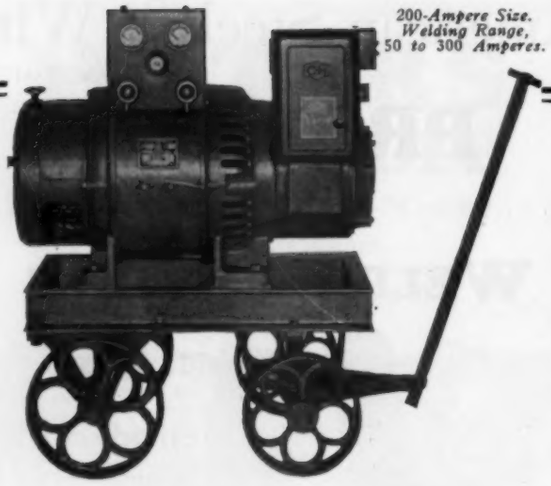

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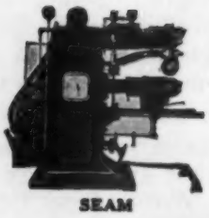

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ELECTRIC and GAS WELDING WIRE

High-Grade
Low-Priced
Guaranteed Analysis
Absolute Uniformity

Immediate Shipment from Warehouse

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"Note the name Weldflo *Each rod the same"*

Representing: TORCHWELD EQUIPMENT CO.

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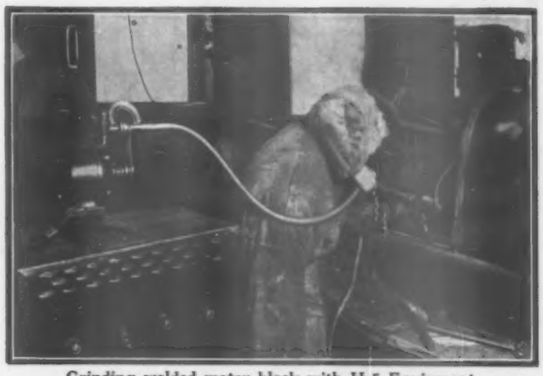

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Transformer Arc Welders (A. C.)
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A complete line of Electric Welding Accessories always carried on hand
Electrodes—Holders—Masks—Handshields—Glasses—Cables, etc., etc.

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Standard size pound box, $4.50.

Crown All-Metal Filler is a mineral composition that repairs cracked waterjackets, motorheads, waterpumps, porous castings, etc., by simply heating the casting to 400° heat and rubbing on the Crown All-Metal Filler, which will penetrate through to the underside and rust up and make a guaranteed, permanent repair. Can be made to flow up, down or sideways. Being gray in color, it blends with cast iron and steel, although it can be used on all metals.

SPECIAL FOR ELECTRIC WELDERS

Crown All-Metal Filler is the only compound that will make an electric weld on cast iron absolutely watertight. It penetrates through the smallest pin-hole where it is possible for water to leak out, and the filler will rust, which is necessary for a permanent repair.

Oldest Exclusive Makers of Aluminum Solders

TRADE MARK

CROWN CROWN CROWN

Crown Aluminum Solder (hard) has been tested by the Bureau of Standards, Washington, D. C., and shown to possess tensile strength of 14,500 pounds to the square inch. Not only is Crown the strongest made, but the easiest to handle and apply, and the saving of labor makes Crown a necessity to every welder.

Crown Aluminum Solder (soft) is recommended for sheet aluminum, particularly on body work and can be applied with ordinary soldering iron. After the solder is properly applied it can't be separated from the aluminum with aid of chisel and hammer. The soft is also recommended for cracks in castings.

Crown Iron Metallic Filler is the incomparable metal for filling scored cylinders. The special Crown acid is supplied free.

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OXYGEN HYDROGEN
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Cylinders—Valves—Regulators
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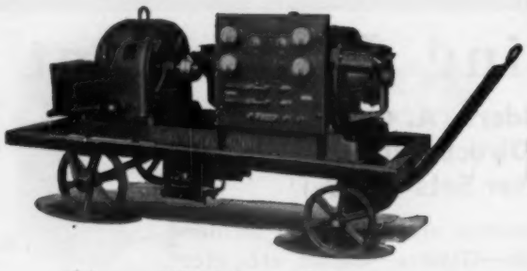

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Burke Variable Voltage Welder

In addition to the single operator type of welder we build a two-operator machine which is distinctively a Burke development.

Either operator can regulate for his own requirements without affecting the other and may use any proportion of the capacity of the welder as long as their total demands are not greater than the rated output of the machine.

The results are self evident—greater production, flexibility and lower cost per weld.

Bulletin No. 133 gives complete description and superior features. *Write for it.*

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Made in all diameters, lengths and sizes.

Small diameter rods are sold in 4, 6 and 8 inch lengths, the shorter the rod the less breakage in shipping.

Also Dixon's Graphite Welding Putty. In 5 and 10 lb. cans.

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PORTABLE ARC WELDER

SPECIFICATIONS

GENERATOR: 300 amperes continuous; 400 amperes intermittent; ball bearing, 950 R.P.M.; extra heavy duty type.

POWER TAKE-OFF: Specially designed for welding service. Connected directly in drive line, provided with shifting lever for driving either car or generator.

GOVERNOR: Patented electric control. Does not affect car speed when generator is idle. Prevents surging of motor. Provides perfect inherent ampere control. Provides extremely elastic arc for all possible welding conditions.

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$1.50 per pair

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Patent Applied for

BUCK SKIN WELD GLOVE FOR WELDERS
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A Grinnell Glove

Made from good heat resisting Buckskin. Has a Special Woven Fabric Palm and Thumb lining with six-inch cuff to protect the arms. Used extensively by General Electric Co. at Pittsfield, Mass., and many other large firms having major welding operations.

MORRISON RICKER MFG. CO.
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The microscope will show you that a weld made with low-carbon, low-sulphur Swedish Iron is remarkably fine-grained and uniform. Seeing is believing.

Give your welder a sample of ***Bisco*** Swedish Iron wire, and let him make a few inches of weld. Let him see its quiet, smooth-flowing action under the flame. He, too, will tell you that seeing is believing.

If you haven't tried BISCO Swedish Iron, send us a trial order.

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The Ideal Glove for Electric and Acetylene Welders is made from Sheep Skin, which has been Subjected to an Asbestos Treatment and which makes it both heat resisting and fireproof.

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are made for every metal and have EXCEPTIONAL merit.

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For bronze welding of Cast Iron.

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SEND $1.00 FOR 5 ASSORTED BRUSHES
Money refunded on return of goods, if not what you want.
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JOHNSON'S MAGIC SOLDER

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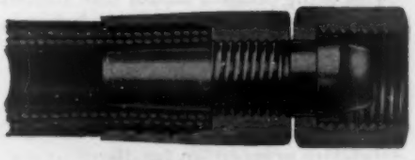

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COULD YOUR PROBLEM BE ANSWERED by the SPOT WELDING of DISSIMILAR METALS?

THE success of the use of Elkonite Welding Electrodes in spot welding dissimilar metals and alloys has brought it to the attention of welding engineers the country over.

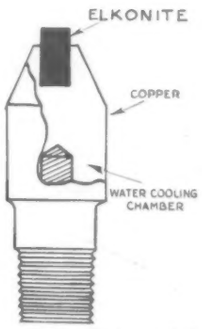


Fig. 1. Water cooled spot welding electrode showing Elkonite Insert. (Courtesy General Electric Co.)

The variable electrical and heat resistance of the different grades of Elkonite Welding Electrodes, plus their ability to hold their shape without mushrooming under red heat, heavy pressures and high currents are properties of immense value.

For this variable, relatively high resistance Elkonite as one electrode, with low resistance Elkonite or copper as the other, gives the balance necessary for even heating to welding temperature of metals of unequal heat and electrical conductivity, such as, for instance, copper with galvanized iron, or with nichrome.

METALS	ALUMINUM	ASCOLOY	BRASS	COPPER	GALVANIZED IRON	IRON	LEAD	MONEL	NICKEL	NICHROME	TIN PLATE	ZINC
ALUMINUM	•											
ASCOLOY		•		•	•	•		•	•	•	•	
BRASS			•	•	•	•		•	•	•	•	
COPPER		•	•	•	•	•		•	•	•	•	
GALVANIZED IRON		•	•	•	•	•		•	•	•	•	
IRON		•	•	•	•	•		•	•	•	•	
LEAD							•					
MONEL		•	•	•	•	•		•	•	•	•	
NICKEL		•	•	•	•	•		•	•	•	•	
NICHROME		•	•	•	•	•		•	•	•	•	
TIN PLATE		•	•	•	•	•		•	•	•	•	
ZINC												•

Fig. 2. Combinations of metals successfully welded with Elkonite. (Courtesy General Electric Co.)

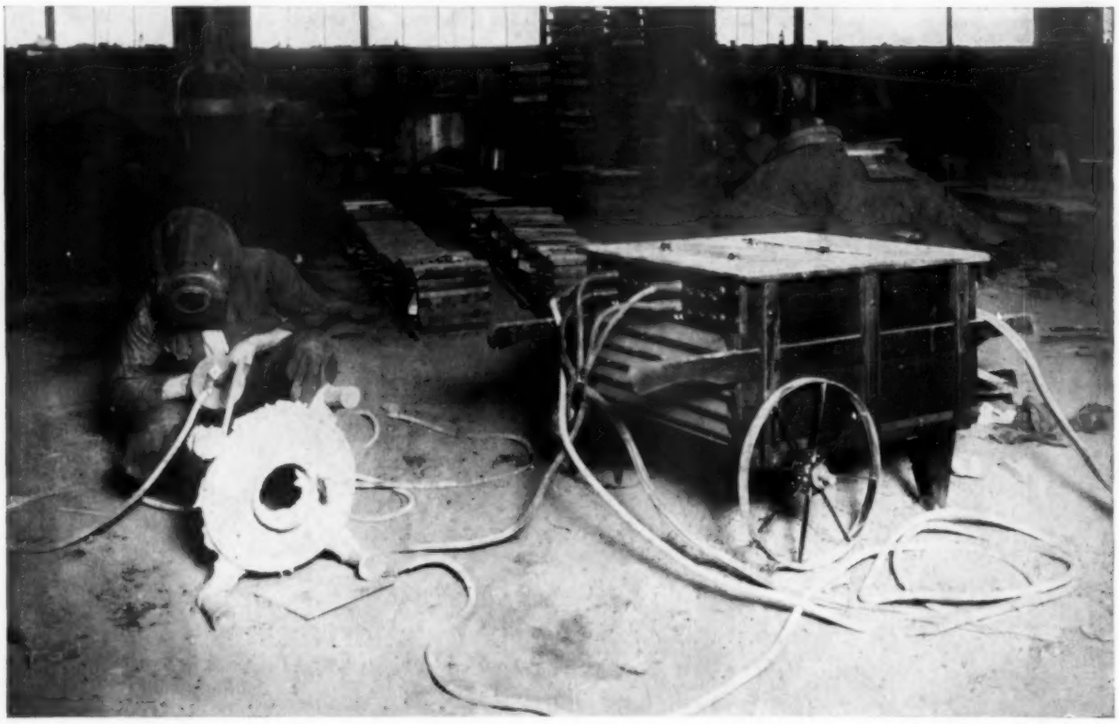
This is but one phase of the contribution that Elkonite has made to resistance welding. In flash, cross-wire, projection welding, electrical upsetting of rivets, as well as in spot welding nonferrous and heavy gauge ferrous metals Elkonite, by eliminating lost time and production due to constant redressing, and shrinkage loss, is showing new economies and production possibilities in many industries.

Our engineering staff will gladly co-operate in any resistance welding problem.

ELKON WORKS Inc.
Subsidiary of P. R. Mallory & Co. Inc.
Weehawken, N. J.

Exclusive licensees under General Electric Co. patents dated May 28, 1925 and Sept. 1, 1925. Other patents pending to Elkon Works.

ALTERNARC WELDERS



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—Cuts 3" x 5" risers in 3 minutes.

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In addition, these cutting machines can also be used for welding, enabling you to get the absolute maximum use from this equipment. Whatever your cutting or welding problems, there is an Alternarc that will do the job economically and well. Tell us your problems. We have a representative in your territory.

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